DIESEL PROGRESS

IN INDUSTRY • IN TRANSPORTATION • ON THE SEA • IN THE AIR

APRIL, 1938 CIRCULATION OF THIS ISSUE — IN EXCESS OF 14,000 COPIES 25c

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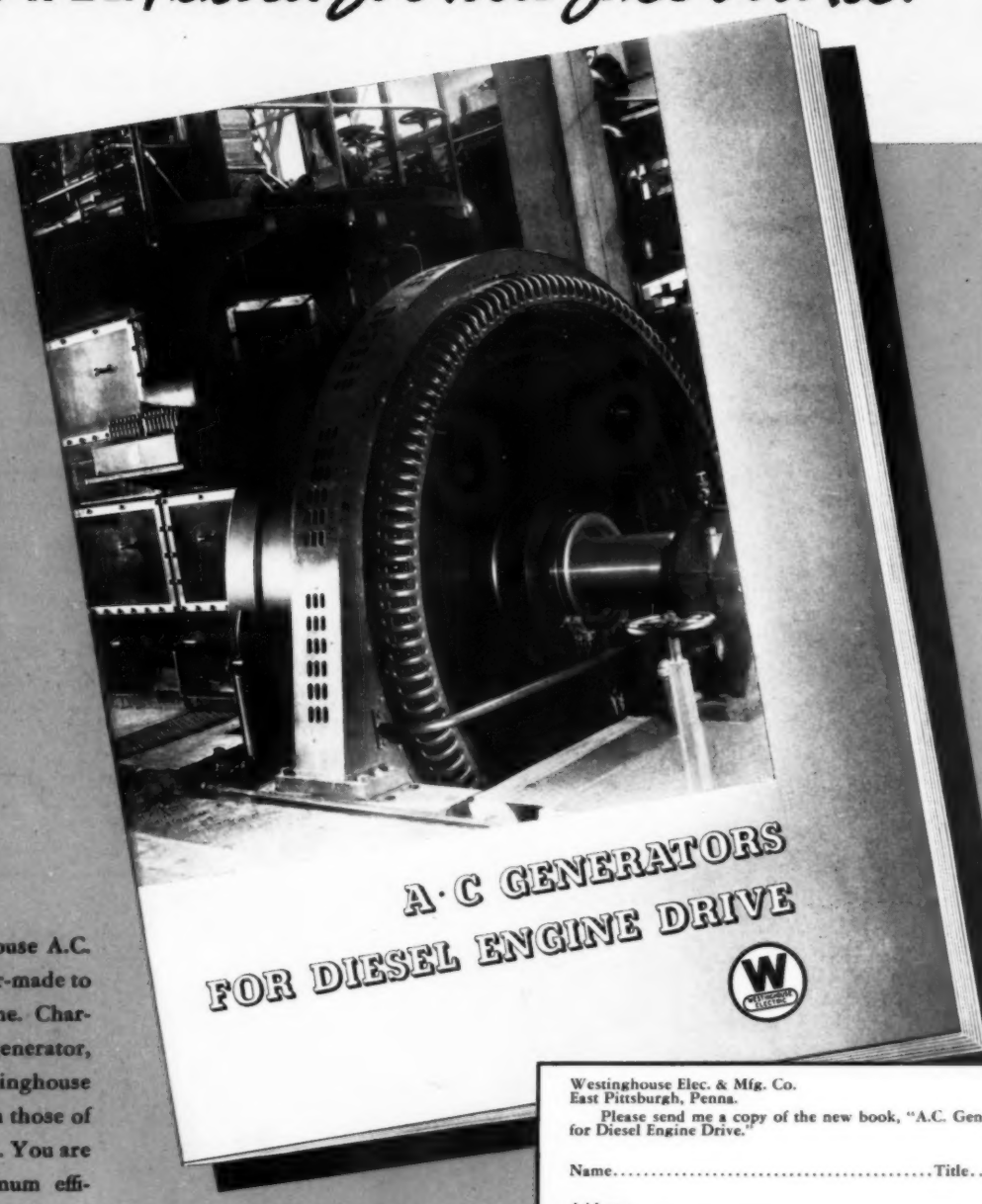

★

EACH Westinghouse A.C. Generator is tailor-made to fit the Diesel engine. Characteristics of the generator, and of the Westinghouse accessories, match those of the engine exactly. You are assured of maximum efficiency and top performance from the installation.

Mail this coupon

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East Pittsburgh, Penna.

Please send me a copy of the new book, "A.C. Generators for Diesel Engine Drive."

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J10071 D.P. 4-38

Westinghouse A·C·GENERATORS *for Diesel Engine Drive*

SWITCHGEAR VOLTAGE REGULATORS EXCITERS AUXILIARY MOTORS AUTOMATIC CONTROL

Both ARE GOOD MEN . . .

but NOT FOR THE SAME JOB

PICKING the right Diesel is just as important as picking the right man for the job. That's why it pays to consult "Diesel Headquarters" first. F-M Stationary Diesels range from compact, portable units of 10 horsepower up to giant heavy-duty models with power enough for a city. F-M Marine Diesels are built for marine service from the bedplate up. They are not adaptations of automotive designs. They range from 10-hp. units for small boats to Diesels large enough for big freighters—F-M Diesel auxiliary power units offer an equally wide choice.

Consider what this means when you are discussing power problems with the Fairbanks-Morse engineer. He doesn't have to recommend a compromise engine. He has the Diesel that is *built for your needs.*

Only a manufacturer who offers a complete line can give you this service. For further information, write Department 23, Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago, Ill. 35 branches throughout the United States at your service.

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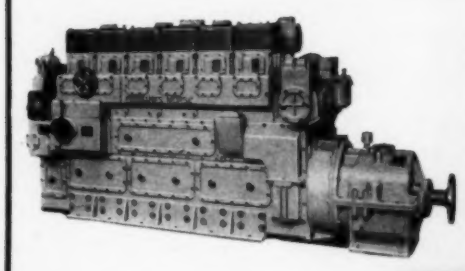
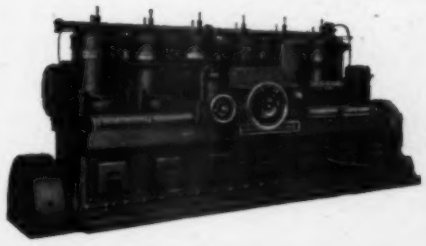
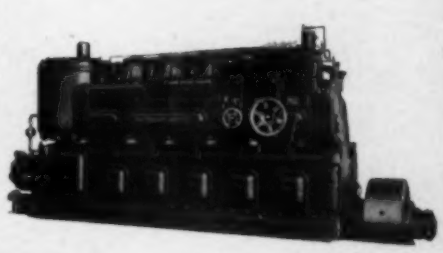
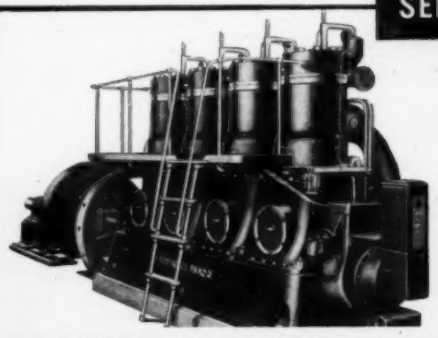
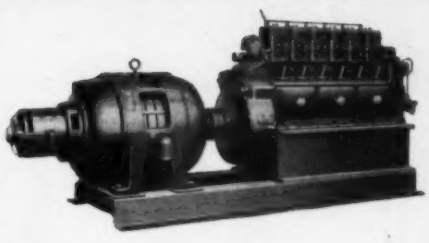


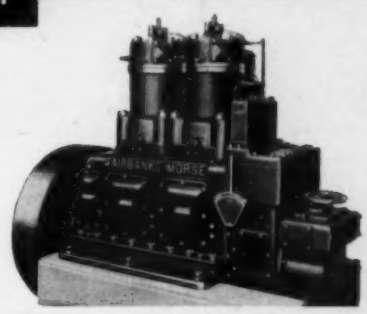




SEE *"DIESEL HEADQUARTERS"* FIRST







FAIRBANKS MORSE Diesels

DIESEL ENGINES
PUMPS
ELECTRICAL MACHINERY
FAIRBANKS SCALES
RAILROAD EQUIPMENT
WATER SYSTEMS
REFRIGERATORS
RADIOS
WASHERS
FARM EQUIPMENT
STOKERS
AIR CONDITIONERS

DIESEL PROGRESS for April, 1938. Volume IV. No. 4. DIESEL PROGRESS is published monthly by Diesel Engines, Inc., 2 West Forty-fifth Street, New York, N. Y. Rex W. Wadman, President. Acceptance under the Act of June 5, 1934, at Brooklyn, New York, authorized May 14, 1935. Subscription rates: United States and Possessions $3.00, Canada and all other countries $5.00 per year. Single copy price 25 cents in U. S. A., 50 cents for all other countries.

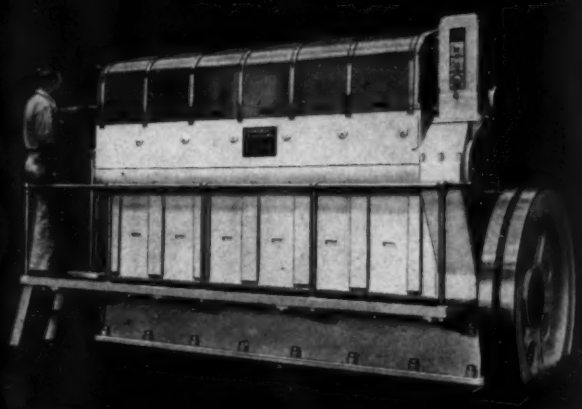
FULTON - DIESEL, bore 17½", stroke 24½", four cycle mechanical injection Diesel engine. This type of engine develops 125 bhp. per cylinder at 225 r.p.m. and is built in three, four, five, six and eight cylinder units.

The engine illustrated is a six cylinder, 750 bhp. unit which, with two eight cylinder, 1000-bhp. units, is being installed in the Central Electric Federated Co-operative Association plant at Pocahontas, Iowa.

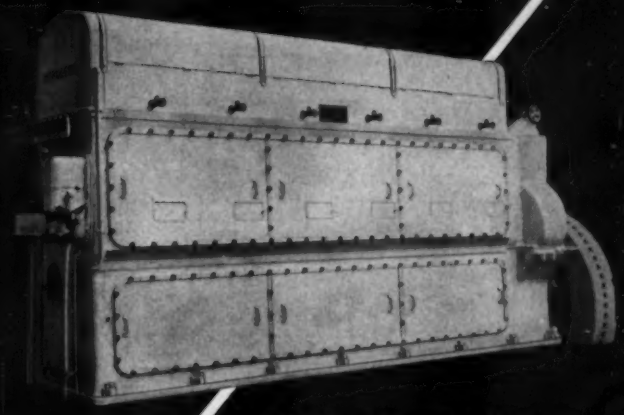
FULTON
DIESEL ENGINES

FULTON IRON WORKS CO., INC.
ST. LOUIS *FOUNDED IN 1852* MISSOURI

THE NORDBERG LINE
Of Better Built Diesels



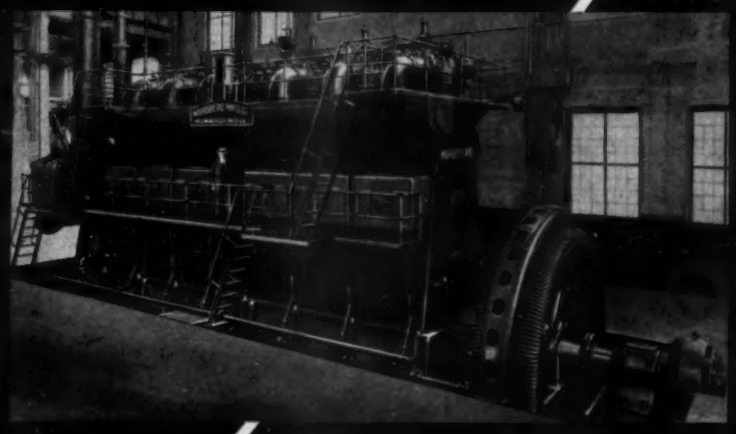
Four Cycle — Six Cylinder — 300 H. P.



Four Cycle — Six Cylinder — 750 H. P.

Two and Four Cycle

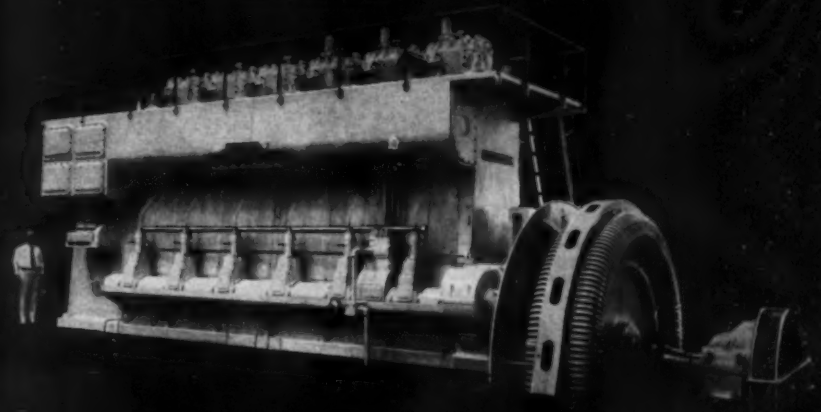
Air and Solid Injection

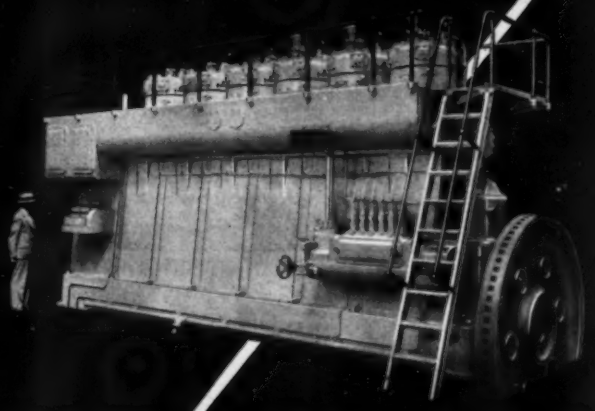


Trunk Piston and Crosshead Construction

From 150 Horsepower Upward

Two Cycle — Six Cylinder — 4000 H. P.



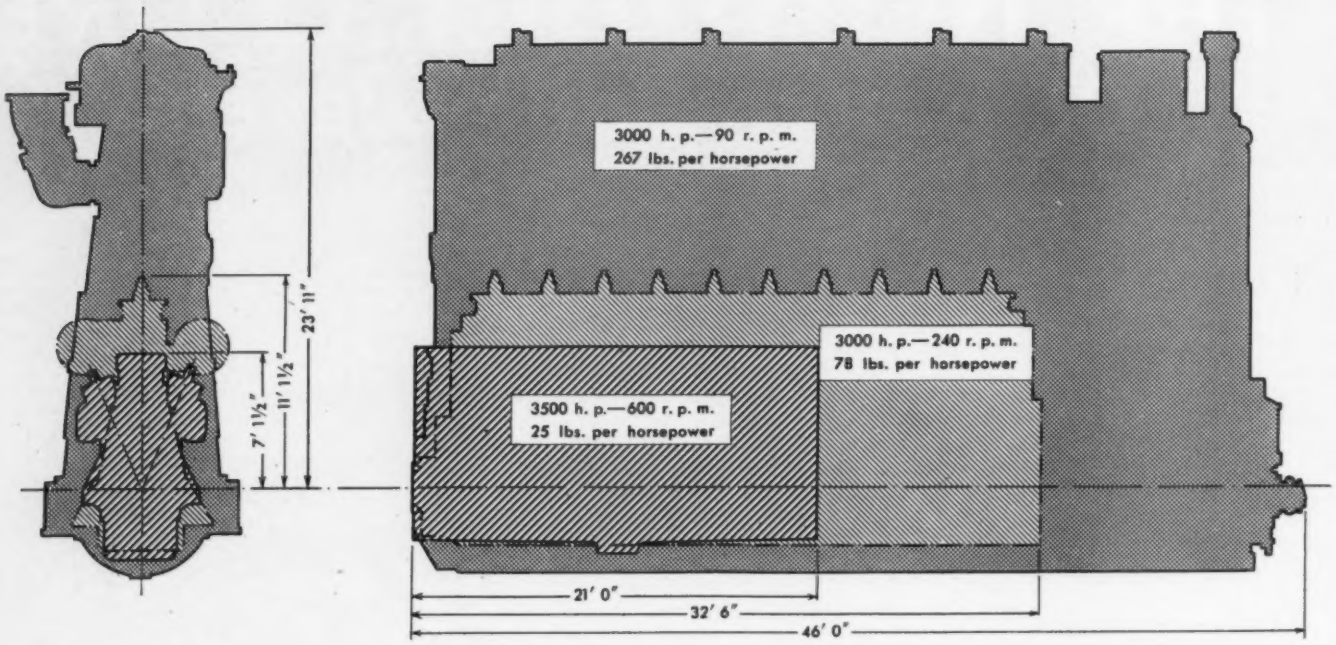


Two Cycle — Six Cylinder — 1500 H. P.

Two Cycle — Six Cylinder — 2250 H. P.

NORDBERG MFG CO., MILWAUKEE

NEW YORK 60 E. 42nd St. | WASHINGTON 917 Barr Bldg. | CLEVELAND 318 Rockefeller Bldg. | KANSAS CITY 3560 Broadway | DALLAS 3801 Potomac Ave. | LOS ANGELES Subway Terminal Bldg.



See what's happened to Diesel Engines

In twelve years their weight has been reduced from 267 pounds to less than 25 pounds per horsepower. This has been accomplished without sacrificing reliability. Intensive research by Diesel engine builders, aided by producers of metals, has made this rapid progress possible.

Typical of this accomplishment is the development of high strength Alloys of Alcoa Aluminum, used extensively where light weight is needed. Some alloys, having extremely low coefficients of expansion, are being used for Diesel pistons. All have the ability to distribute heat rapidly, a property vital to many Diesel engine parts.

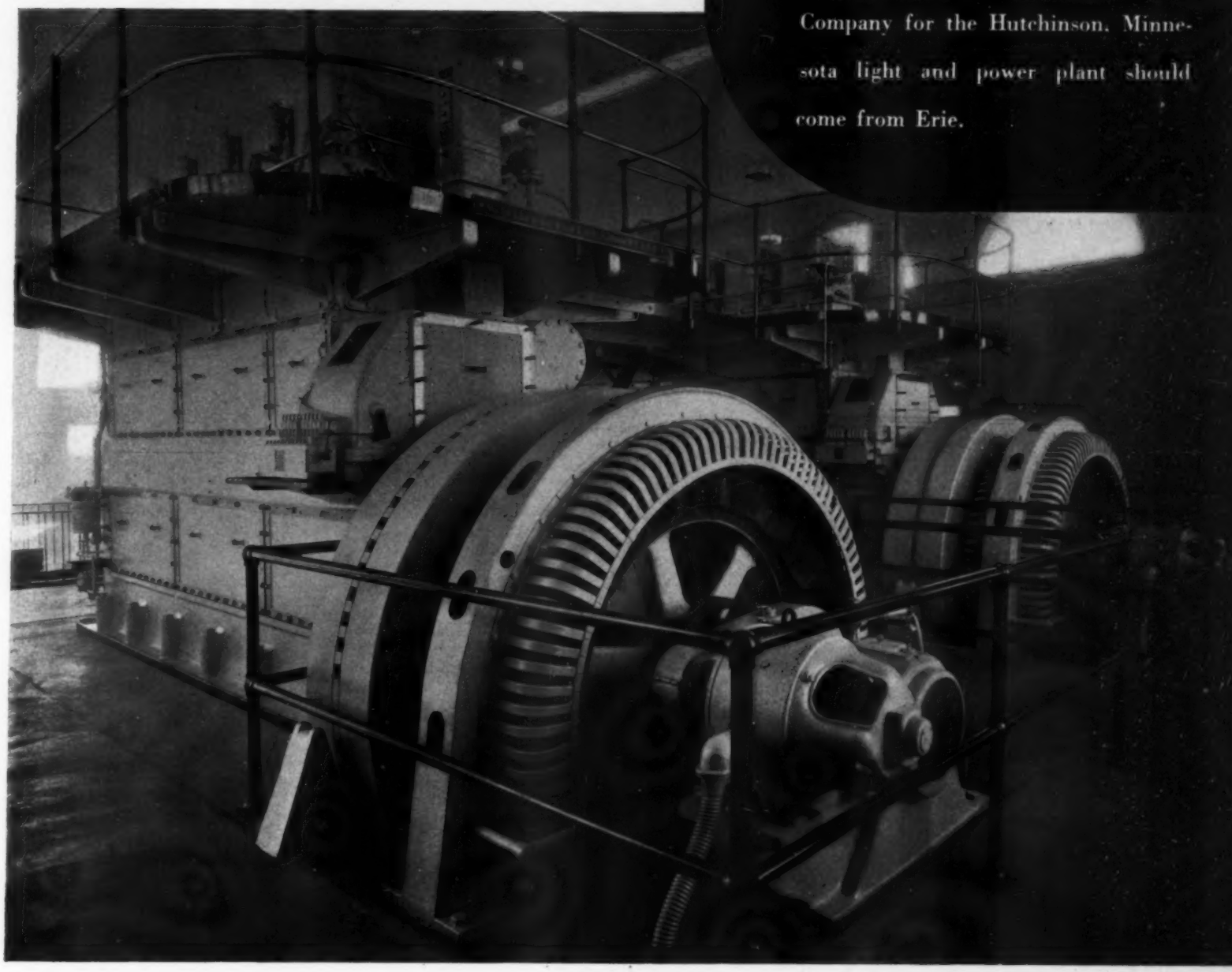
Equally important has been the perfection of methods of fabricating Aluminum. Intricate castings weighing as much as 7500 pounds, and forgings ranging from a fraction of a pound to hundreds of pounds, are produced successfully. Diesel engine builders have adopted Aluminum because it has helped them improve their product. ALUMINUM COMPANY OF AMERICA, 2141 Gulf Building, Pittsburgh, Pennsylvania.

ALCOA · ALUMINUM

Long life and durability are essential in the successful performance of Stationary or Marine Diesel installations. That's why it is just as important to choose the right crankshaft as it is to choose the right Diesel.

E R I E

It is but logical that the crankshafts selected by American Locomotive Company for the Hutchinson, Minnesota light and power plant should come from Erie.



Leading engine builders rely upon Erie Forge experience and complete facilities for the manufacture of crankshafts and other forged parts, finished to the most exacting tolerances.

Rough and finished connecting rods, piston rods, crossheads, generator and extension shafts for all Diesel engines. Prompt delivery on all major forged or cast steel elements required in every type of construction.

ERIE FORGE COMPANY

ERIE, PENNSYLVANIA

Let the MACMILLAN MAN show you how to reduce maintenance costs

No matter what type of industrial equipment you use (gasoline, diesel or natural gas), The Macmillan Man can quickly prove: that Macmillan RING-FREE Motor Oil reduces friction more than any other oil; that it can't help but reduce fuel and repair bills!

Let The Macmillan Man show you why RING-FREE stands up better under heat and heavy use; how it removes carbon; how it penetrates hard-to-reach parts. After all, it costs nothing to have your plant or equipment superintendent see the simple, telltale tests on RING-FREE...and report his own conclusions to you.

There's a handy coupon at the right...use it!

MEMO To Macmillan Petroleum Corporation
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Please have The Macmillan Man call on our...

Mr. _____

Firm _____

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MACMILLAN PETROLEUM CORPORATION

50 WEST 50th STREET, NEW YORK • 624 SOUTH MICHIGAN AVENUE, CHICAGO • 530 WEST SIXTH STREET, LOS ANGELES

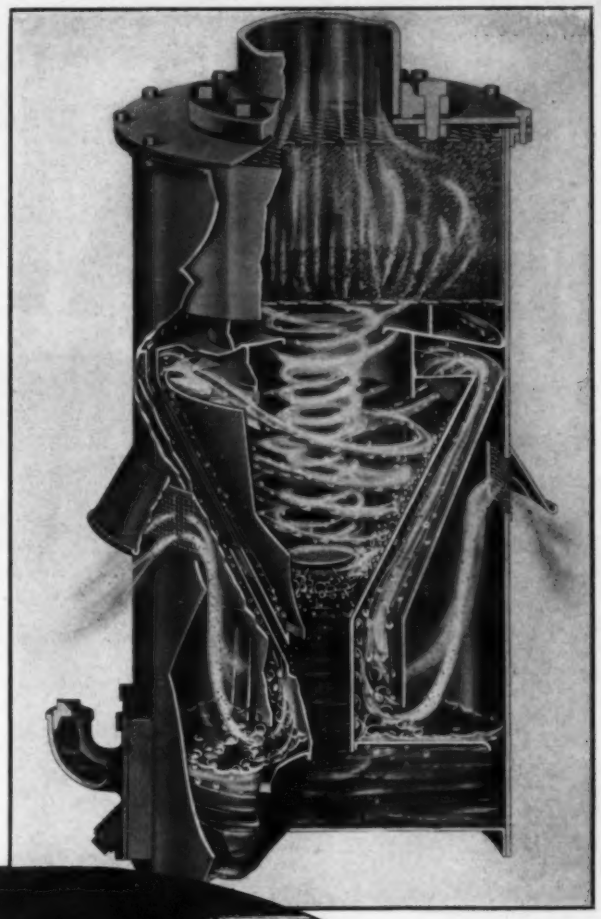
ANNOUNCING
The NEW *Cycoil*
(OIL BATH AIR CLEANER)
WITH THE 4 in 1 CLEANING PRINCIPLE

THE CYCOIL is the only oil bath filter on the market which provides an efficient pre-cleaner for removal of the large linty or fibrous matter before the air is brought in direct contact with the filter element.

Actually four distinct methods of cleaning are combined in the Cycoil (note the direction of the air flow in the cross section illustrated).

1. **Impingement of the air against the surface of the oil to remove the larger and heavier dust particles.**
2. **Scrubbing action of the air against oil coated surfaces.**
3. **Cyclonic action of centrifugal force to throw the dust and oil spray out of the air stream.**
4. **Filtration as the final cleaning stage before the air enters the engine or compressor.**

Such a combination provides maximum efficiency in dust removal and the highest degree of air cleanliness. The Cycoil is recommended for the protection of compressors and Diesel engines, especially in areas of high dust concentrations. Send for Bulletin No. 130. Use Quickmail coupon No. 2 for convenience.

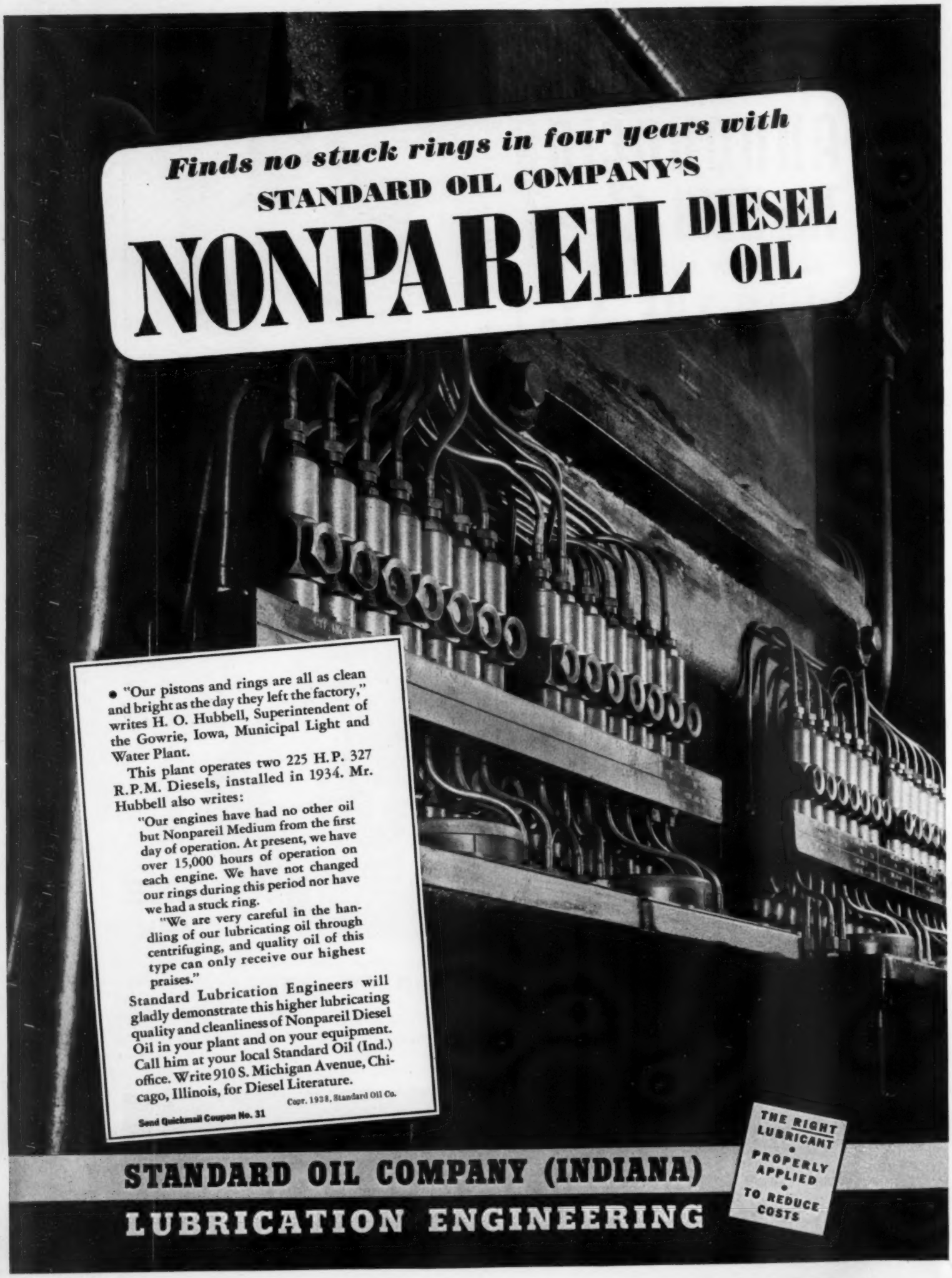


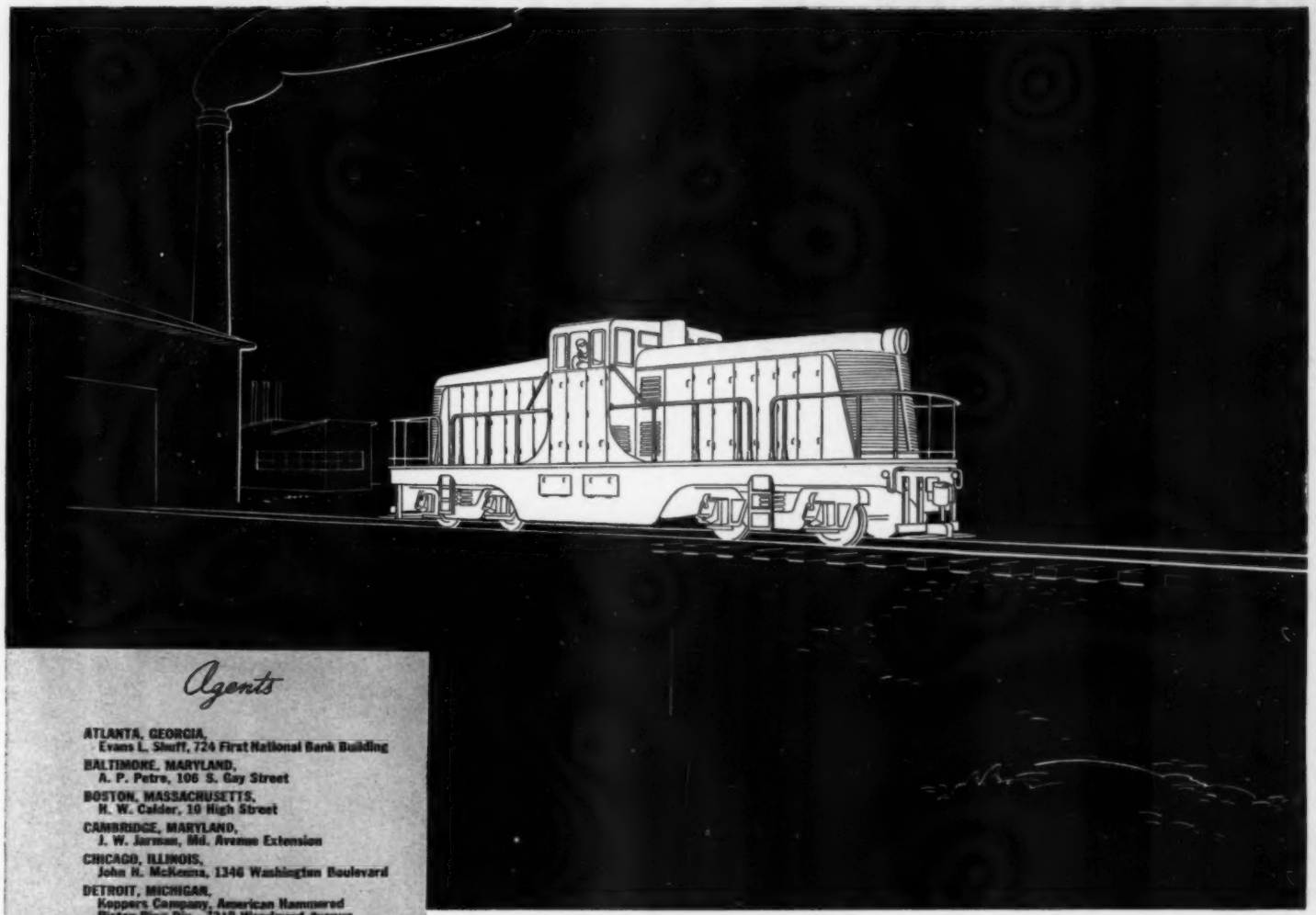
Cross section of Cycoil showing direction of air flow and action of pre-cleaning principles.

Four sizes are available ranging from 12 inches to 24 inches in diameter.

AMERICAN AIR FILTER CO., INC.
Incorporated
112 CENTRAL AVENUE, LOUISVILLE, KY.
In Canada: Darling Bros., Ltd., Montreal, P. Q.

AMERICAN *Cycoil* OIL BATH AIR CLEANER


Finds no stuck rings in four years with
STANDARD OIL COMPANY'S
NONPAREIL DIESEL OIL
• "Our pistons and rings are all as clean and bright as the day they left the factory," writes H. O. Hubbell, Superintendent of the Gowrie, Iowa, Municipal Light and Water Plant.
This plant operates two 225 H.P. 327 R.P.M. Diesels, installed in 1934. Mr. Hubbell also writes:
"Our engines have had no other oil but Nonpareil Medium from the first day of operation. At present, we have over 15,000 hours of operation on each engine. We have not changed our rings during this period nor have we had a stuck ring.
"We are very careful in the handling of our lubricating oil through centrifuging, and quality oil of this type can only receive our highest praises."
Standard Lubrication Engineers will gladly demonstrate this higher lubricating quality and cleanliness of Nonpareil Diesel Oil in your plant and on your equipment. Call him at your local Standard Oil (Ind.) office. Write 910 S. Michigan Avenue, Chicago, Illinois, for Diesel Literature.
Copr. 1938, Standard Oil Co.
Send Quickmail Coupon No. 31
STANDARD OIL COMPANY (INDIANA)
LUBRICATION ENGINEERING
THE RIGHT LUBRICANT • PROPERLY APPLIED • TO REDUCE COSTS



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MILEAGE "IN THE METAL" MEANS MILEAGE ON THE RAILS

Illustrated is one of two Cooper-Bessemer 1000-hp Diesel Locomotives built for the Ford Motor Company. American Hammered Piston Rings are used.

American Hammered Piston Rings have established remarkable records for service in the railroad field. This service is *built-in* at every stage of manufacture, starting with the metal. Eighteen different alloys are regularly used in the manufacture of American Hammered Piston Rings. The nature of the application determines what type of metal shall be used . . . and governs every step in design and manufacture.

American Hammered Piston Ring engineers specialize on the solution of difficult ring problems and have solved them in every branch of industry. Perhaps the rings can add power or cut costs for you. Why not find out? Koppers Company, AMERICAN HAMMERED PISTON RING DIVISION, BALTIMORE, MD.

Rings for Cooper Bessemer equipment can be obtained from builder.

American Hammered Piston Rings

a KOPPERS product

Use Quickmail Coupon No. 30

OUT AND IN IN A JIFFY!

Renewable Pumping Units Save Time In The New TIMKEN Fuel Injection Pump

TIMKEN Fuel Injection Equipment now not only gives the compression-ignition engine operator superior performance and greater economy. It assures him against prolonged operating delays as well... through a new feature... *renewable pumping units.*

This great advancement makes it very rarely necessary to remove the TIMKEN Fuel Injection Pump from the engine. By keeping a spare set of pumping units on hand the operator is able to maintain the pump in tip-top condition with little or no time off the job.

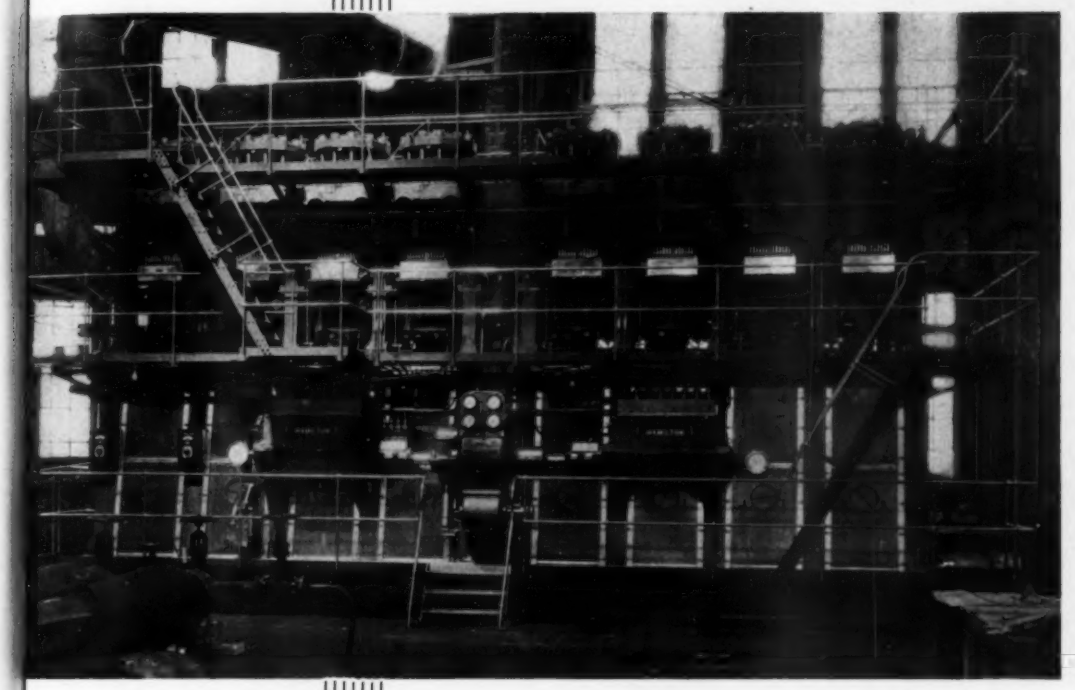
When necessary, any individual pumping unit can be renewed as easily as a spark plug can be changed in a gasoline engine. Simply remove two small nuts, slip out the old unit, slip in the new one, replace the nuts. It is impossible to put it in the wrong way.

TIMKEN Fuel Injection Equipment—including pump, governor, timer and nozzles, all of the highest quality and precision—is a product of an All-American company which has become one of the world's most famous engineering-manufacturing institutions. When writing for further information mention the make, model and horsepower of your engine.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN
FUEL INJECTION EQUIPMENT

SALT RIVER VALLEY WATER USERS' ASSOCIATION BUYS A *SECOND* 7000 H. P. DIESEL



Two of these 7000 hp. Hamilton-M.A.N. Two-Cycle, Double Acting, Eight-Cylinder, 24" x 36" Diesel Engines have now been purchased by the Salt River Valley Water Users' Association.

LAST Fall the Salt River Valley Water Users' Association, Phoenix, Arizona, purchased a 7000 hp. Hamilton-M.A.N. Diesel Engine. They have now purchased a second unit of the same size. These 7000 hp. eight-cylinder, double acting, two-cycle, 24" bore, 36" stroke, engines will be exact duplicates of the five units installed at Vernon, Calif., with the exception that the generators on this new installation will be 25-cycle units. Both of these engines are to be used for standby and peak load service for the Association's hydro-electric system.

HAMILTON - M. A. N.

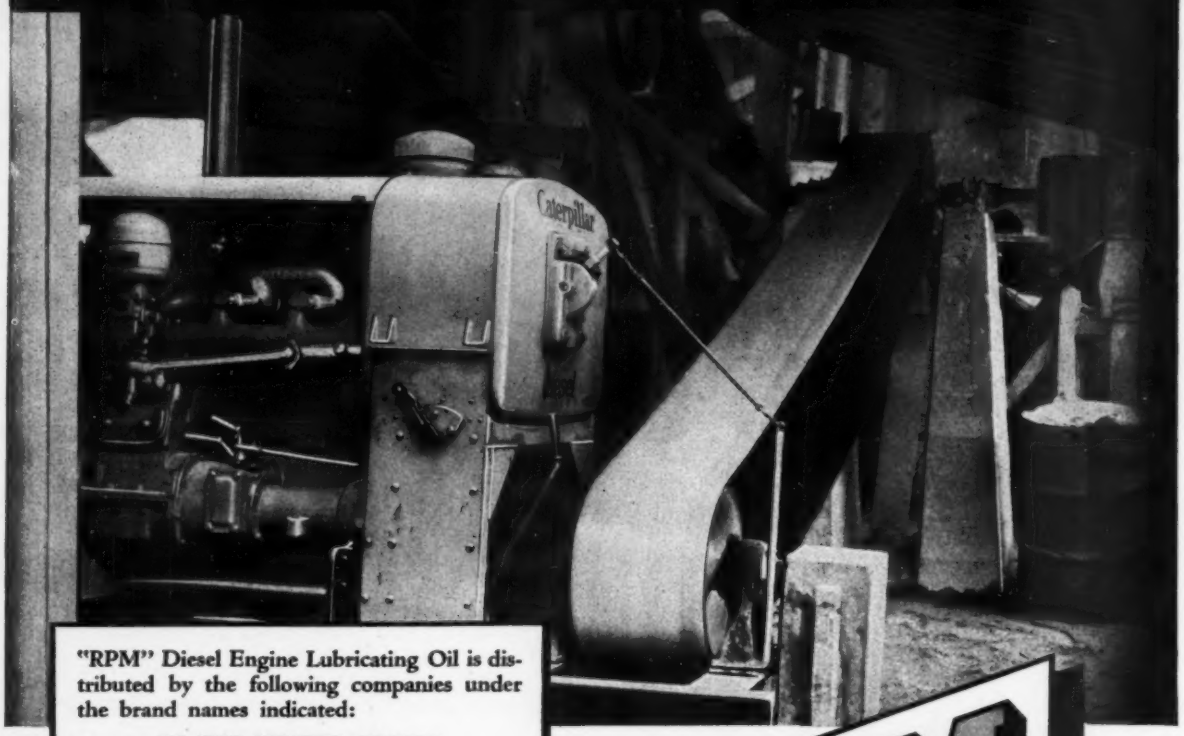
GENERAL MACHINERY CORPORATION

Hooven, Owens, Rentschler Division

Hamilton, Ohio

More "RPM" Diesel Engine Lubricating Oil is being sold and used in "Caterpillar" Diesel Engines than all other Diesel oils combined

STANDARD OIL COMPANY OF CALIFORNIA



"RPM" Diesel Engine Lubricating Oil is distributed by the following companies under the brand names indicated:

IN THE UNITED STATES

"RPM" Diesel Engine Lubricating Oil:
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THE CARTER OIL COMPANY, Tulsa, Oklahoma
HUMBLE OIL & REFINING COMPANY
STANDARD OIL COMPANY (Indiana)
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STANDARD OIL COMPANY OF NEW JERSEY
STANDARD OIL COMPANY OF PENNSYLVANIA

Signal "RPM" Diesel Engine Lubricating Oil:
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Sohio "RPM" Diesel Engine Lubricating Oil:
THE STANDARD OIL COMPANY (Ohio)

IN CANADA

"RPM" Diesel Engine Lubricating Oil:
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STANDARD OIL COMPANY OF BRITISH COLUMBIA LIMITED

THROUGHOUT THE WORLD

"RPM" Diesel Engine Lubricating Oil is also available through distributors in more than 100 other countries.

RPM
TRADE MARK REGISTERED
DIESEL ENGINE LUBRICATING OIL

LOOK FOR THIS NAME

The "RPM" trade-mark appears on every container of genuine "RPM" Diesel Engine Lubricating Oil. It is your assurance of superior lubrication.

Approved by CATERPILLAR TRACTOR CO.

Use Quickmail Coupon No. 19

IN THIS new 105-ton Davenport Diesel locomotive, four V-8 "Caterpillar" Diesel Engines on main generator drives and a 4-cylinder "Caterpillar" Diesel Engine for auxiliary uses, develop a total of 760 horsepower.

Any or all of the main-drive units can be put into action, as tractive needs may demand. And even if one or two should become temporarily disabled, the others can carry on or bring the locomotive to the servicing point under its own power.

The economies from this truly low-cost, flexibly available power are obvious. So, too, the greater dependability. For independent or auxiliary power — for portable or stationary machinery and equipment of all kinds — consider the expertly engineered and widely proved efficiency of "Caterpillar" Diesel Engines . . . *plus* the complete, world-wide parts-and-service facilities behind them.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

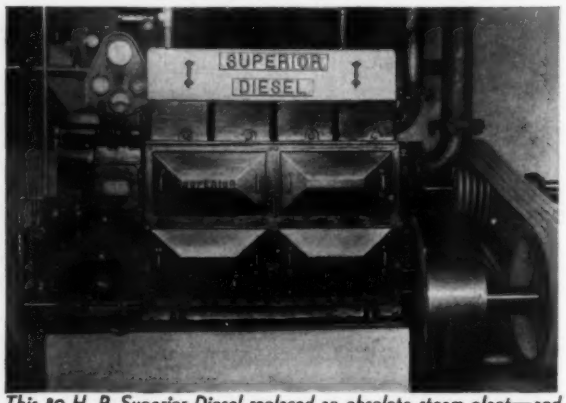
8 ENGINE SIZES. 8 GENERATOR-SET SIZES. ***Leading machinery and equipment manufacturers power their products with "Caterpillar" Diesels***

CATERPILLAR DIESEL POWER

DIESEL ENGINES • TRACK-TYPE TRACTORS • ROAD MACHINERY

SERVING and SAVING WHERE POWER LINES DO NOT GO

The Bowen Elevator Co., recently acquired by the New Paris Elevator Co., was completely remodeled and made one of the best-equipped, small country elevators in its locality.



This 80 H. P. Superior Diesel replaced an obsolete steam plant—and it works for about $1.75 per day.

Superior DIESELS

HEAVY DUTY MODELS: 50 to 810 H.P., 250 to 720 R. P. M.

HIGH SPEED MODELS: 15 to 150 H.P., 900 to 1800 R. P. M.

Altho the demand for rural electrification is strong and both private and government capital are striving to meet that demand, it is needless to believe that the next 5 or 10 years will see more than a fraction of the rural homes and remotely located small power users supplied from transmission lines. There will always remain small isolated power users and mining and quarrying developments beyond economical reach of such power.

For such power users, Superior Diesels of all sizes are ready to serve—year after year—at a cost from a few cents to a few dollars a day.

Such was the case of the Bowen Elevator Company which had no power line to tap, but whose alert management realized that a Superior Diesel could be put in at once and still produce power for less than any probable rate when the power line might come.

Buy your Superior Diesel now! Your investment in it will be protected by its long life and economy years from now.

Use Quickmail Coupon No. 13

THE NATIONAL SUPPLY COMPANY

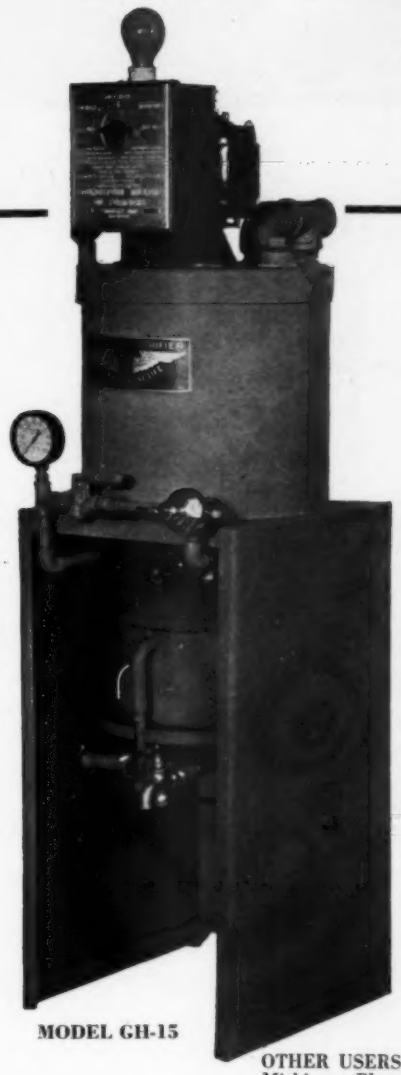
SUPERIOR ENGINE DIVISION

FACTORIES: Springfield, Ohio; Philadelphia, Pa.
SALES OFFICES: Springfield, Ohio; Philadelphia, Pa.; New York, N. Y.; Los Angeles, Calif.; Houston, Texas.

Lubricating Oil *Can Be Kept* Clean!

Instead of This . . .

Used oil sampled from the engines at Tipton, Indiana, on the day the Youngstown Miller Purifier was installed.



MODEL GH-15

You Can Have This!

Unretouched photograph of the same oil as shown opposite, when cleaned by Tipton's newly purchased Y-M unit.

This is not unusual performance for Y-M purifiers and shows that used oil need never be discarded. It is also conclusive proof that lubricating oil can be kept clean while in service—that engines need not operate with dirty oil at any time.

Fuel dilution — acids — water — sludges — gums — abrasives—all can be removed by any size of Youngstown Miller unit.

The Tipton engines are shown below. The Chief Engineer states, "The old oil in our engines is now as clear as the day it was put in them."

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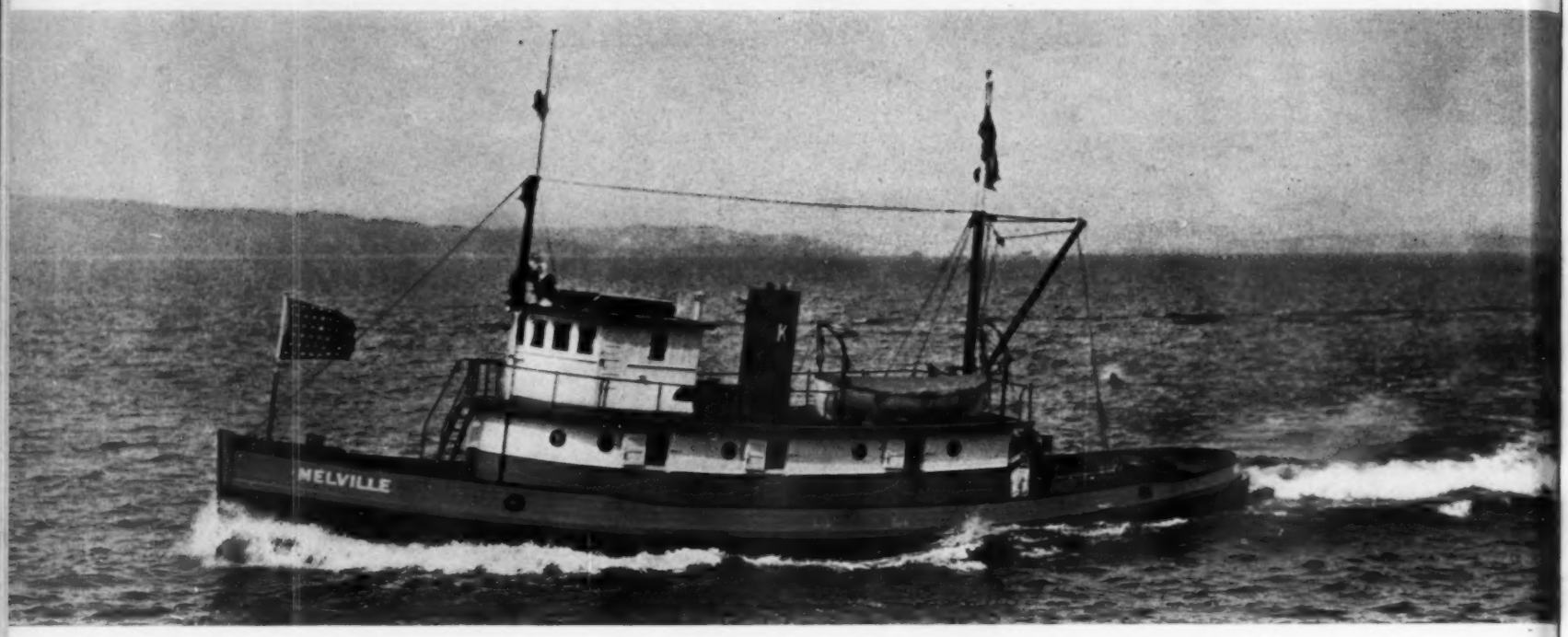

"Melville" Equipped with SENTINEL Fuel Filter. 440 HP Washington Diesel

THE Knappton Towboat Company installed their first SENTINEL filter on their tug *"Melville"* two years ago. They believed then as they do now in clean fuel and lubricating oil. They have learned from actual experience that there is no greater economy or a shorter cut to securing clean fuel and lubricating oil than the use of SENTINEL oil filters on their Diesel engines.

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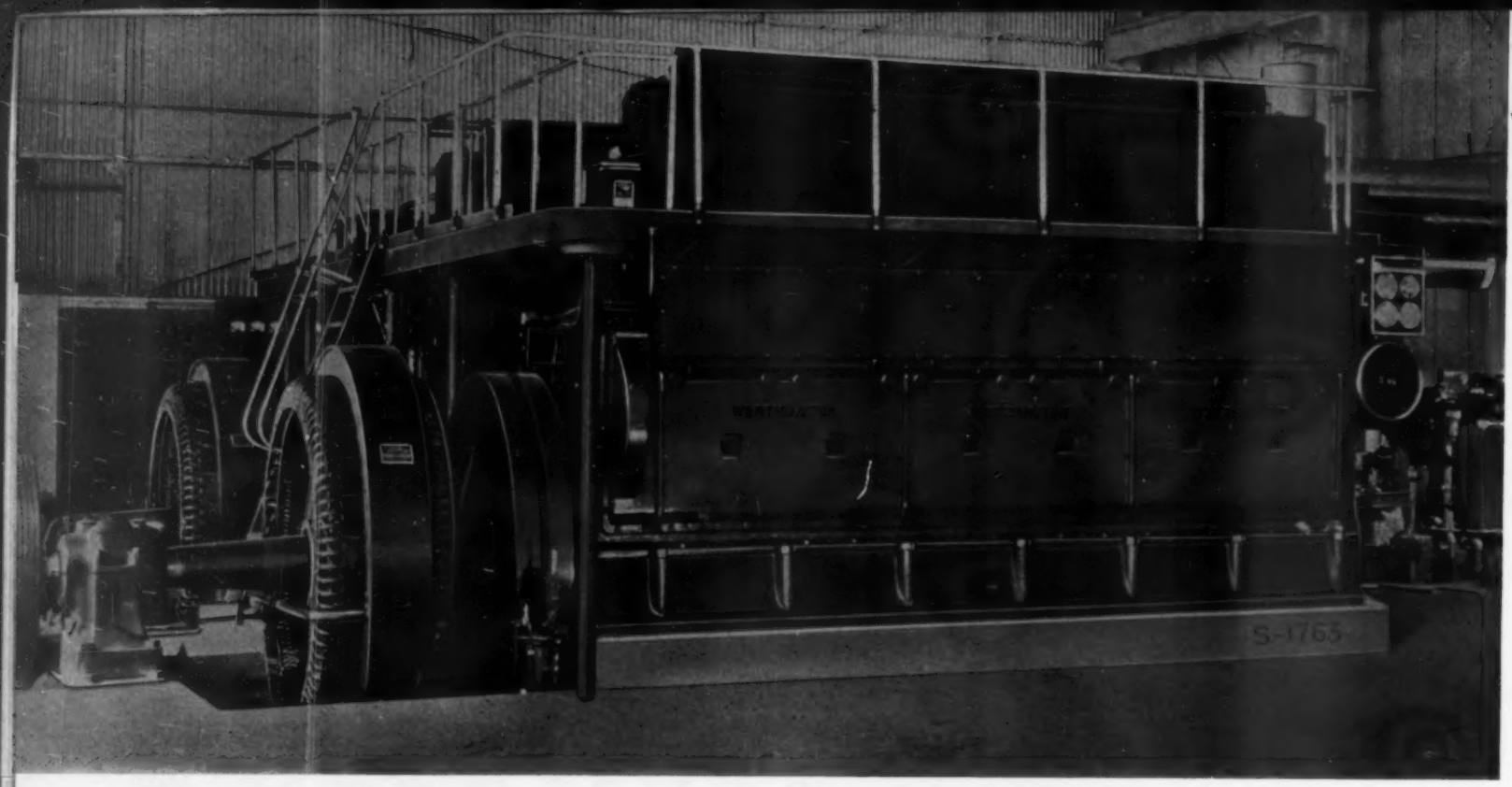

Two Worthington convertible Diesels, 6 cylinder 690 hp. at 327 rpm., operated by the Magnolia Petroleum Corporation, Stonewall, Oklahoma. American Bearing Corp. bearings installed in these engines.

BEARING ON BEARINGS

TO THE UNINITIATED, a bearing may appear to be nothing more complicated than an over-size napkin ring. To the purchaser, a bearing is a metallic cushion that, while supporting a shaft, allows it to rotate freely under load. The buyer, the engine builder or operator, wants a bearing that does its job so well that it seldom calls attention to itself. He wants a bearing that lets his engine, like ol' man river, "just keep rollin' along."

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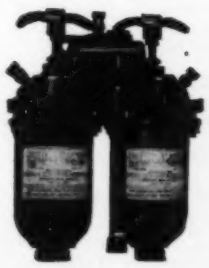

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Type D-48JJ-3 Purolator is designed for successful handling of fuel filtration where there are no shut-down periods. Two identical units (with knife-edge cleaning elements) are mounted with a two-way shut-off control. Either unit may be cut out of service for cleaning without interfering with operation of the other unit.

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DIRT is the arch-enemy of Diesel operation. Keeping dirt out of Diesels is a task worthy of specialized filtering experience. And—Purolator has capable and seasoned filtration engineers working on this very problem!

Purolator engineers are constantly engaged in development work to provide positive protection for old and new Diesel types. We are specially prepared to work out new designs for advanced requirements. Address your inquiry to Motor Improvements, Inc., Newark, N. J.

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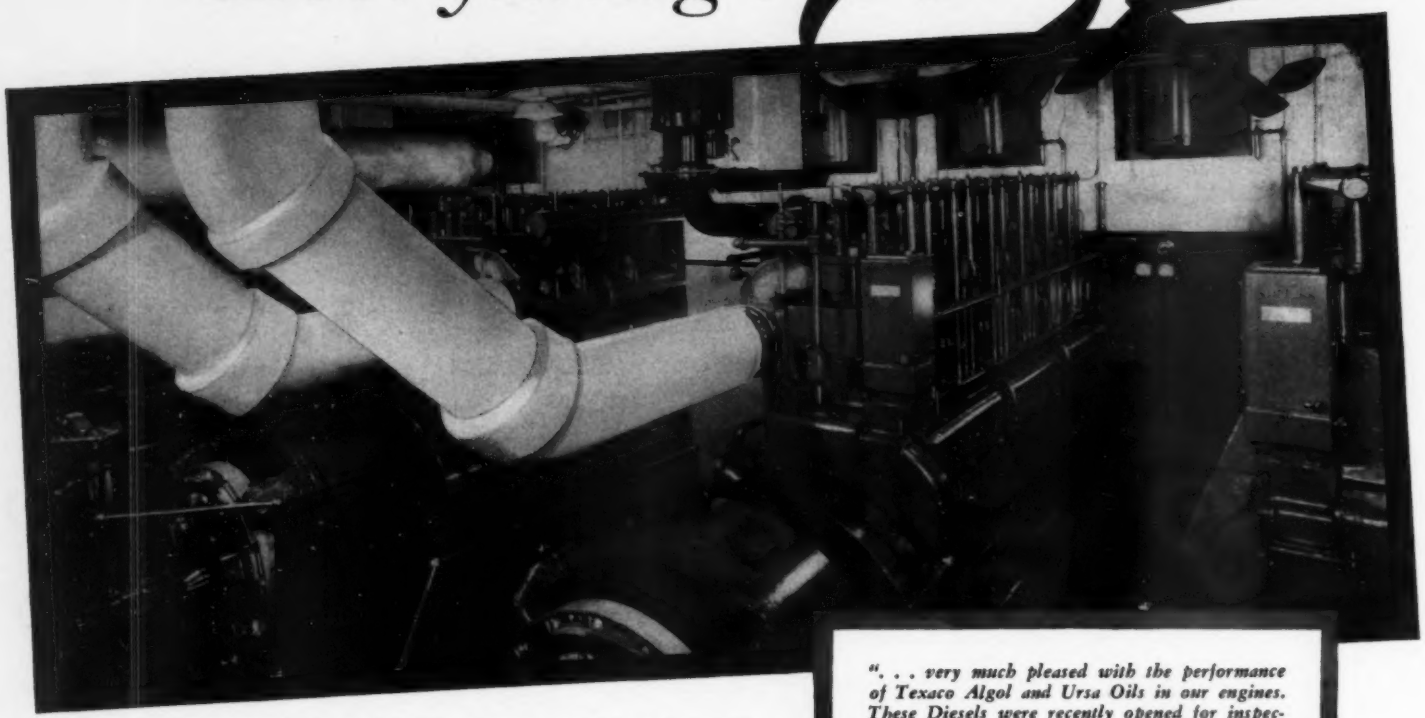
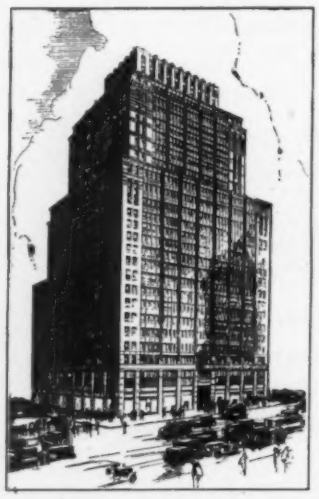


This general engine room view at No. 2 Park Avenue shows the excellent use of small space to provide a compact yet accessible set-up. Each of the four 450 h.p. Worthington Diesels is Texaco lubricated. These Worthington Diesels use Texaco Ursa in the cylinders, Texaco Algol in the bearings. "Wear and carbon negligible," was the report after 3,000 hours of operation.

". . . very much pleased with the performance of Texaco Algol and Ursa Oils in our engines. These Diesels were recently opened for inspection and the pistons pulled after 3,000 hours of service. No stuck rings were found and only a very negligible amount of carbon. The engines were clean. All bearings, cylinders, and rings were in fine condition."

ROY O. WOOD, *Chief Engineer*



No. 2 Park Avenue, New York City, housing the power plant shown above, where Texaco Algol and Ursa Oils are keeping everything O.K.

Here's how they know that everything's O.K. in this power plant at No. 2 Park Avenue, New York City . . . 26-story office and display building. After 3,000 hours of operation, they pulled the pistons, and proved once more the perfect fitness of Texaco Algol and Ursa Oils for Diesel lubrication.

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The Texas Company, 135 East 42nd Street, New York City.

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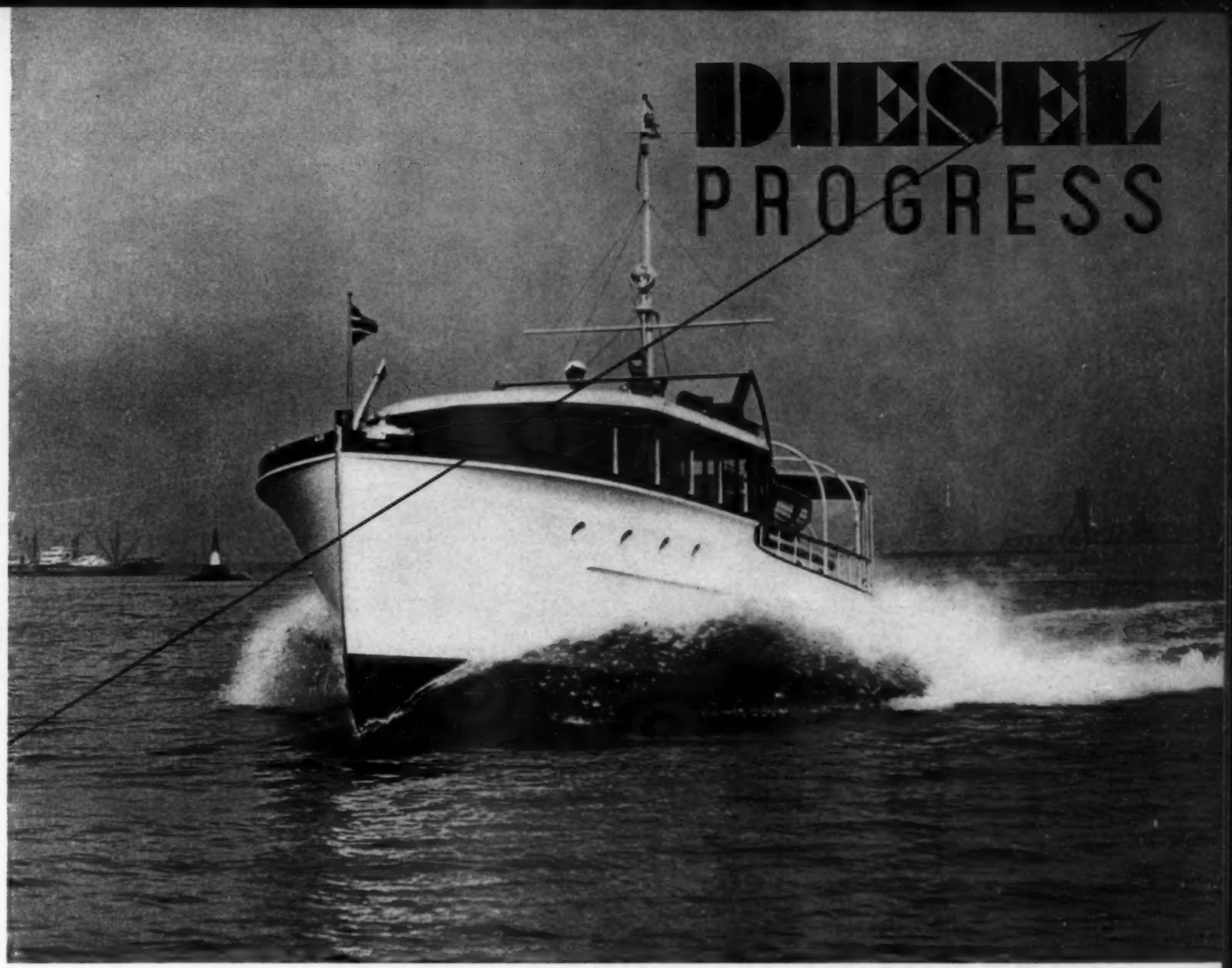

REX W. WADMAN
Editor and Publisher

FRONT COVER ILLUSTRATION: Exterior of new Mt. Wilson Observatory on top of Palomar Mt. in Southern California. See article on pages 24, 25, 26 and 27.

TABLE OF CONTENTS ILLUSTRATION: A standardized Elco 53-foot Diesel cruiser in action. This particular boat is powered with a pair of Superior Diesel engines.

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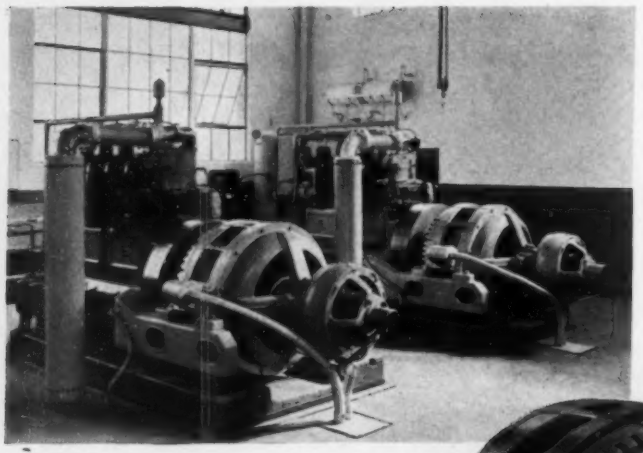

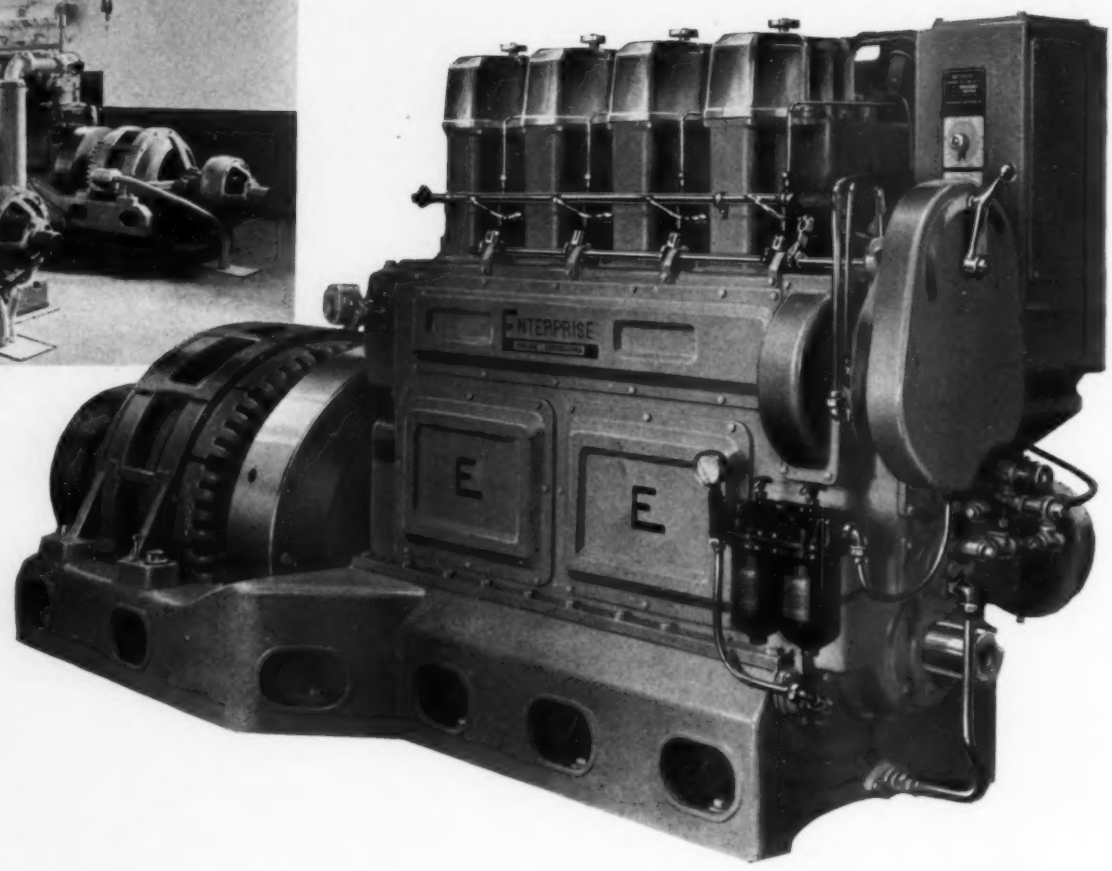

Two Enterprise Type DSL-4, 120 Hp. Diesel Engines installed at Palomar Observatory. Below—Observatory under construction.

ENTERPRISE Diesel Power at Palomar

DIESEL engines were first considered as standby power at Palomar, when two 120 Hp. Enterprise engines were selected in 1936. The units were installed and have now been in operation for sixteen months under most critical observation of operating characteristics, dependability and economy. So convincing was the performance that, by unanimous vote, the committee in charge decided upon the exclusive use of Diesel engines for power, heat and light. A third Enterprise diesel, Type DSW-6, 225 Hp., is now being built to complete the plant requirements.

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REX W. WADMAN, Editor and Publisher

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Rex W. Wadman

EXPLORING THE UNIVERSE WITH DIESELS

By EMMETT M. IRWIN*

ON Palomar Mountain in Southern California there is being constructed the world's largest scientific instrument, the 200-inch telescope. This telescope will be the world's largest by virtue of the main mirror which will be 200-inches in diameter, twice the diameter of the present largest telescope. This mirror will have four times the light gathering power of the 100-inch mirror and with the improved construction made possible by the new advances in science and industry, will give the astronomer an instrument by which he can penetrate farther into space and into the intricacies of the universe.

Construction of this telescope is being undertaken by the California Institute of Technology with funds made possible by the National Education Board of the Rockefeller Institute. The site for the construction is on a 5500 ft. high mountain top in San Diego County. The location is about 100 miles air line from Los Angeles and 45 miles from San Diego. At present the construction crew of about fifty people is housed in a modern construction camp and cottages and is provided with all modern utilities including power, light, water, fire protection, gas, sewage, private dial telephone exchange and an ultra short wave radio telephone circuit communicating with the campus of the California Institute of Technology at Pasadena from which point the project is being directed.

The 200-inch telescope in addition to being a complex optical system for receiving the light from the distant heavenly bodies and accurately concentrating it at a focus for the astronomer, is a marvel of engineering. The 200-inch mirror and mounting, weighing about 35 tons when completed, will be moved with extreme smoothness and precision by the telescope structure so as to face any portion of the sky. The tube which carries the 200-inch mirror is a large structural mass 60 feet in length and 22 feet in diameter. It will be finely pivoted to the telescope yoke mounting which in turn is mounted for movement parallel to the earth's axis on a horseshoe bearing 46 feet in diameter. The entire telescope structure weighing 450 tons will be floated on oil and precisely driven by electric motors.

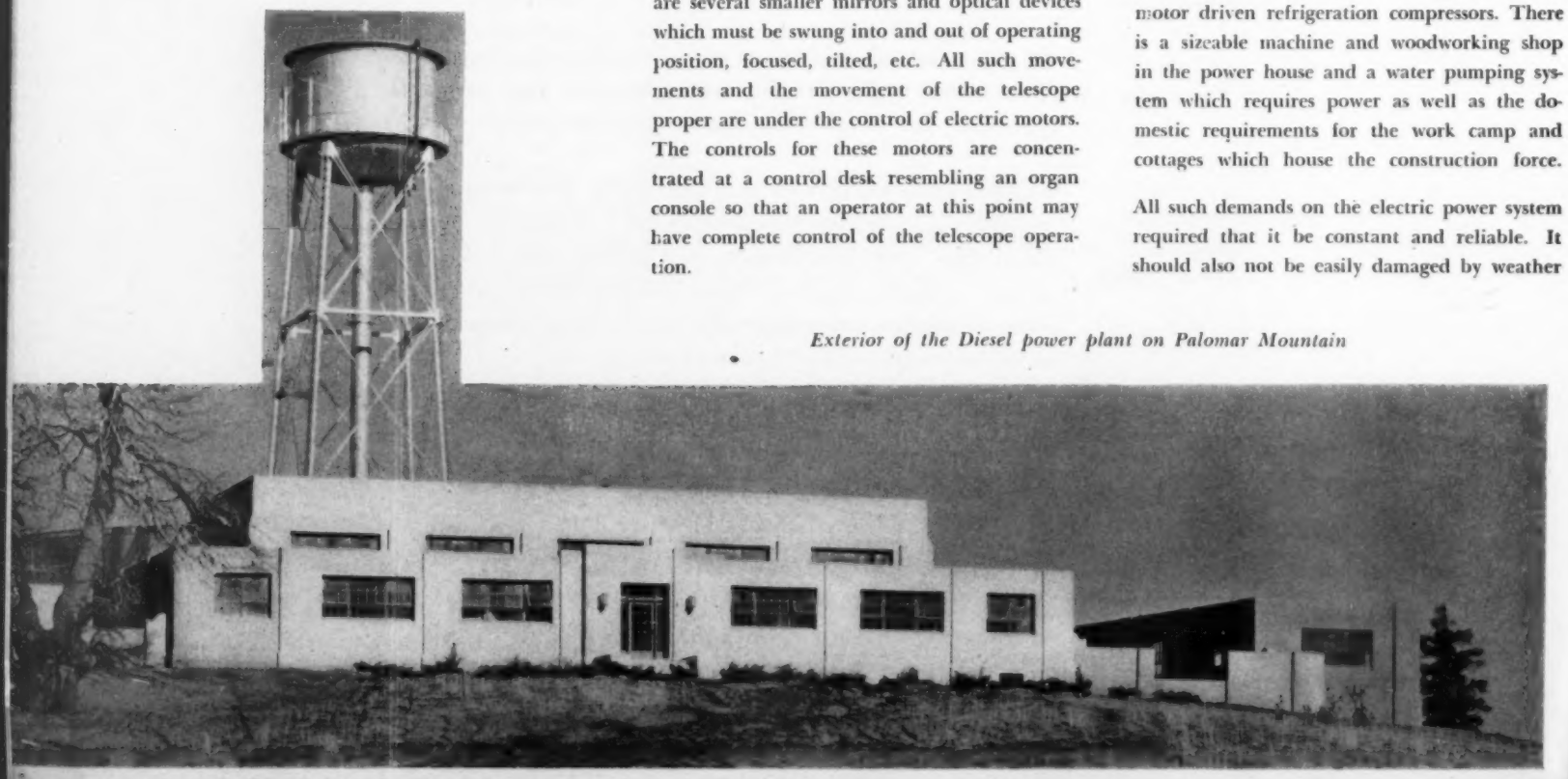
In addition to the main 200-inch mirror, there are several smaller mirrors and optical devices which must be swung into and out of operating position, focused, tilted, etc. All such movements and the movement of the telescope proper are under the control of electric motors. The controls for these motors are concentrated at a control desk resembling an organ console so that an operator at this point may have complete control of the telescope operation.

The accurate control of the telescope required a reliable source of electric power and one which would provide substantially constant frequency and voltage with fluctuating loads. The drive of the telescope to maintain it accurately aimed to the remote stars requires accurate power at the same time other loads at the site produce wide fluctuations in the power demand. For example, the telescope itself will be housed in a circular building 135 feet in diameter and surmounted by a hemispherical dome. This dome provides the opening through which the telescope may peer out at the heavens and is a welded steel structure weighing 1050 tons. This entire dome is mounted on trucks rotating on a circular track on the periphery of the building. The dome structure may be rotated by electric motors to bring the shutter opening opposite the end of the telescope. These electric motors must produce a maximum of 35 horsepower for rotating the dome.

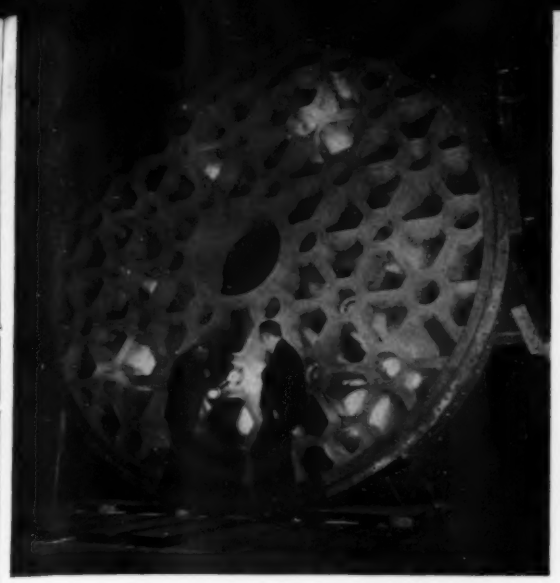
There are many other requirements for power at the site. These include a 60-ton crane in the telescope dome for hoisting parts of the telescope and power for air conditioning several rooms in the dome. All such air conditioning is accomplished by electric heating and electric motor driven refrigeration compressors. There is a sizeable machine and woodworking shop in the power house and a water pumping system which requires power as well as the domestic requirements for the work camp and cottages which house the construction force.

All such demands on the electric power system required that it be constant and reliable. It should also not be easily damaged by weather

*Consulting Engineer, also Chief Electrical and Utility Engineer for the 200" Telescope Project.



Exterior of the Diesel power plant on Palomar Mountain



200-inch mirror photographed at works of Corning Glass Company before shipment to California.

Exterior of the new Observatory being built on top of Palomar Mountain in Southern California.

conditions so that the telescope would not be rendered useless after a heavy storm. It was, therefore, necessary to provide at the Palomar Mountain site a reliable source of electric power. A public utility company had power available at the foot of the mountain and about eleven miles from the site. In order to obtain power from such a source, it would be necessary to construct a line over rugged country and across the top of the mountain for about six miles. This latter portion of the line would be subject to damage by lightning during part of the year and by sleet and snow during the winter. The construction costs of such a line would be high due to the rugged country traversed and even though a large portion of the expense would be borne by the power company, it still left considerable expense for the Institute to absorb.

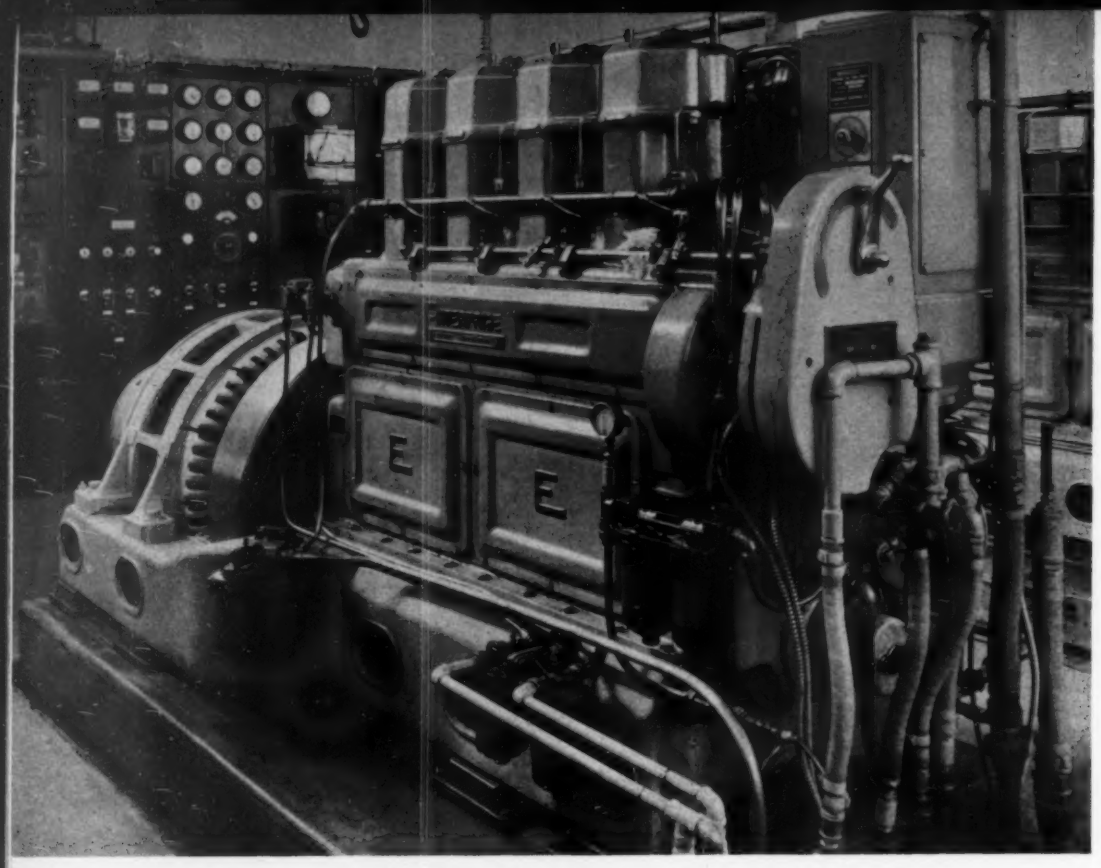
After weighing all phases of the question, it was decided that a standby plant at the site would be a neccessity even though power were purchased, because of the necessity of having reliable power at all times for the telescope. It was further decided to construct the standby plant at once and operate it during the construction period in order to obtain data as to operating costs to determine the future policy regarding power generation. This standby plant was to consist of two 60 kw. Diesel generating units having sufficient overload rating to withstand the expected power peaks.

Pacific Enterprise Products, Inc. of Los Angeles were the successful bidders for the generating units and supplied two Enterprise Diesel generating units. Each unit consists of an Enterprise, 8-inch bore x 10-inch stroke, 600 rpm., four cylinder, four cycle, solid injection, Diesel engine direct connected to a General Electric synchronous generator rated 75 kw., .8 power factor, 480 volts, 3 phase, 60 cycle and having a direct connected exciter. The units have a normal rating of 60 kw., but are capable of carrying an intermittent load of 75 kw. At rated speed and load the piston speed is 1,000 ft. and the B.M.E.P. is 60 pounds.

In selecting the engines for this plant several features of rather unique character had to be considered to adapt the engines to supply the power necessary for the 200-inch observatory. One of the principal considerations was that of vibration. Since the 200-inch telescope is a delicate scientific instrument capable of receiving and projecting a beam of light for as much as 500 feet, it was essential that there be no equipment at the site which would transmit to the ground any vibration of sufficient magnitude to affect the telescope. As the magnitude of the vibration which would disturb the telescope was not known, it was decided to establish some standard to which the engine builder could work and at which his responsibilities could stop. This limit was established as a vibration of .0003 inches of the ground in the immediate vicinity of the generating units. This vibration was to be measured on a pier or other rigid structure resting solidly on the ground.

To meet these specifications on vibration the Enterprise generating units were provided with a very rigid base structure which was mounted on Korfund type D Vibro-Dampers, twelve dampers being supplied for each generating

Switchboard showing location of Leeds & Northrup frequency control devices and Brown pyrometer, etc.



One of the two Enterprise Diesel engines, showing Korfund Vibro-Dampers, Woodward Governor and Purolator Filters.

unit. The Vibro-Dampers rest on a concrete block having about twice the mass of the generating unit. The concrete block extends into pits in the power house floor and in turn is supported on a layer of vibration cork which rests on a concrete slab at the bottom of the pit. This construction provides two vibration absorbing structures between the generating units and ground with a concrete block between. The calculated coefficient of transmissibility is 1/85. That this type of construction is effective in reducing the amount of vibration transmitted to the ground is borne out by results, as tests made at the installation indicate that the vibration transmitted to the ground is well within the specified amount.

The possibility that the power system may be subjected to highly fluctuating loads due to the rotation of the dome, hoisting with the crane, etc., made good speed regulation on the generating units essential. Accordingly they were provided with Woodward type IC governors. These governors are equipped with synchronizing motors to permit synchronizing the generators from the switchboard. They also have speed droop and load limit controls. With these governors and extra heavy flywheels the units are capable of furnishing very constant frequency current even with fluctuating loads.

Engine lubrication is by pressure system throughout. It is provided by a pressure lubricating oil pump which pumps the oil to the main, connecting rod, wrist pin and rocker arm bearings. Pistons are lubricated from crankcase spray and in addition by an engine driven Manzel lubricator which supplies additional oil to the cylinder walls. The surplus oil from the pressure lubrication collects in the crankcase from which it is pumped by a scavenger pump to a lubricating oil sump tank in the basement. This tank has ample capacity to permit the oil to remain quiescent for a sufficient time so that dirt may settle out. The pressure lubrication pump takes oil from the sump tank and pumps it through edge filters and a Harrison lubricating oil cooler to the pressure system. Oil is further filtered by a battery of four Luberfiner filters connected to a bleader from the pressure lubrication system. These filters are of the activated clay type and assist materially in keeping the oil clean and free of acids. In addition the oil is treated at intervals of 1,000 hours with a mixture of activated clay, soda ash and steam. Laboratory tests on the oil have shown that with this system it is possible to maintain the oil in nearly perfect condition with the result that it is not necessary to change the oil at intervals. This eliminates the wastage of used oil and contributes materially to the economy of the power generation.

The cooling system is rather unique in engines of this size as Young radiators are used in place of conventional cooling towers. A cooling tower was objectionable for several reasons. In the first place, water is obtained from springs located about half a mile from the site and the capacity of the water supply in a dry season is unknown. Then the liberation of a quantity of warm moist air might cause haze or fog conditions which would interfere with the use of the 200-inch telescope. For these and other reasons it was decided to use radiators instead of cooling towers.

A novel method is employed to utilize the heat in the cooling water to heat the power house. The cooling coils comprising the Young radiators are arranged in two sets, one above the other, and each engine connected to a radiator. The radiators are connected to the intake of a conventional ventilating fan so that air is drawn through the radiators by the fan. Arranged in front of each radiator are shutters which are operated by a motor controlled by a thermostat located in the water line which leaves the radiators and supplies the engines. This thermostat is set so that the shutters start to shut off the flow of air to the radiators whenever the temperature of the water drops to 145°F. Likewise, the thermostat is set to open the shutters at 147°F., thus maintaining constant temperature on the water inlet to the engine.

The outlet from the fan is selectively controlled to discharge the heated air either through a vent duct to the inside of the power house or through a grille in the power house wall to the outside. A thermotsat located so as to be contacted by the return air from the power house is connected to control motor-operated shutters in the discharge duct and direct the flow of air inside or outside the building. In winter the air is circulated around and around inside the power house and in summer fresh air is pulled through the power house and the heated air discharged outside.

Since approximately 600,000 Btu. per hour of heat is liberated in the cooling water of the two engines when operating at full load, there is sufficient heat available to fully heat the building even in winter time. This system of cooling the engines has been found to maintain very constant temperature operating conditions on them and has also eliminated the expense of heating the power house. This heating would amount to a considerable expenditure as the temperatures are below freezing for a considerable portion of the time in the winter.

After the telescope is put into operation the personnel at the site will be rather lim-

ited. For this reason the power plant was built so that it would require a minimum of attendance for its operation. The generating units were, therefore, equipped with protective devices which will shut the unit down in case of failure of oil pressure, water circulation, abnormal heating of the water or overspeed.

Also to reduce attendance and insure high quality of power output, certain automatic control features were installed which are somewhat unusual for a plant of its size. These devices were manufactured by Leeds & Northrup Company and include devices for regulating frequency, maintaining load balance on the engines when operating in parallel and for integrating the frequency so as to hold time on synchronous clocks. The purchase of this equipment was warranted because of the increased use to which the electric power could be put in connection with the observatory. For example, it is desirable to have the frequency controlled accurately enough so that synchronous motors operating from the generated power can be used for driving instruments such as siderostats, coelostats, etc., which require accurate speed control. This accurate frequency is obtained by the Leeds & Northrup frequency controller which controls the synchronizing motors on the Woodward governors to maintain constant frequency. The load controls are actuated by the balance of load between the two engines when operating in parallel and also regulate the Woodward synchronizing motors to maintain equal loads on both engines.

Every observatory must have an accurate source of time. In most observatories this is obtained by a master clock in one telescope building and there then arises the problem of getting this time to other buildings where other telescopes are located. At Palomar there is at present one small telescope in addition to the future 200-inch telescope and there will probably be additional ones in the future. It was, therefore, thought advisable to put one accurate master clock in the power house and use it in conjunction with the Leeds & Northrup equipment to control the frequency of the generated power so that synchronous clocks could be used where desired. A Warren master clock was therefore purchased and connected to hold time in the system. Accuracy of the clock is about ¼ second per day and this is checked by way of short wave radio with time signals sent out by the Government. It is interesting to note that the standard time in use is not the exact sidereal time used by astronomers, the difference being several seconds per day. A question, therefore, was raised as to whether the master clock and electric system should be adjusted for standard or sidereal time. It was finally decided to operate on standard time and buy clocks for the observatory buildings which would have the correct gear ratio to change the time to sidereal time.

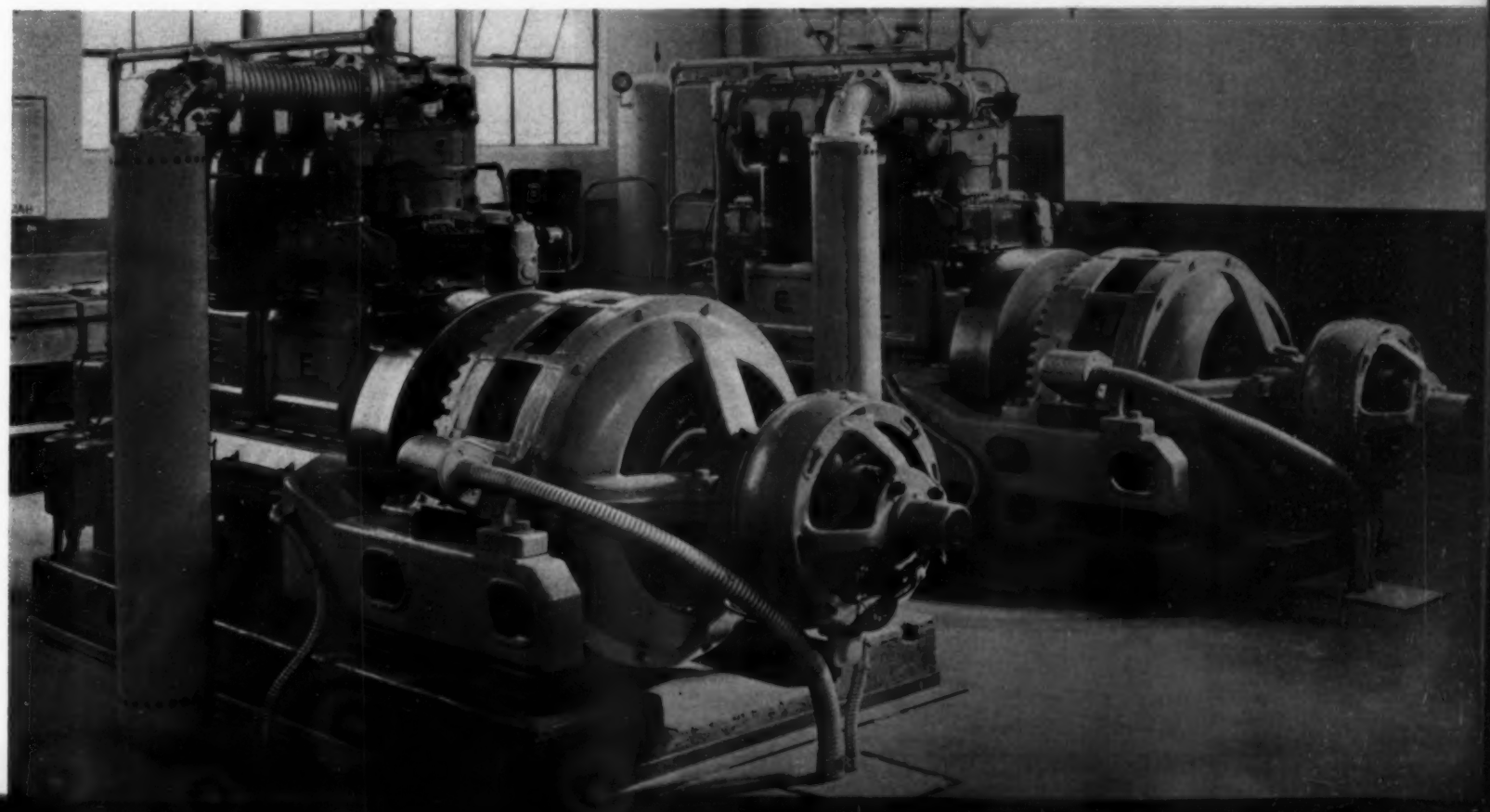
Since the power plant is isolated and power must be maintained at all times, the switchboard is somewhat elaborate. Complete facilities are provided for synchronizing the engines and metering the power generated. There is also a double bus system provided so that one bus may be de-energized and safely worked on without shutting the power off. It also provides for isolating one or more sets on a bus for special work on experiments. In line with the other features the voltage regulators are of the high speed vibrating type and these, operating in conjunction with special low reactance (27%) generators, are effective in maintaining very excellent voltage regulation on the plant.

The power plant was put in service in October, 1936, and since that time has carried a variety of loads. At first the load was quite light and then gradually built up. For the past several months it has been supplying a heavy fluctuating load caused by construction work on the huge telescope dome. The hoisting of the dome plates into position and the welding required a maximum of these hoists and fifteen welding machines. This extremely fluctuating load has been satisfactorily carried by the plant with, of course, both engines operating in parallel. Instantaneous peaks have reached 260 kw. on the plant. Both voltage regulation and speed regulation have been very good considering the tremendous load surges.

With such highly varying loads the greatest economy cannot be expected from the plant. However, the monthly report of plant operation shows quite good economy considering that the engines have never been given a complete overhaul since being put into operation. Th following is a summary of the plant log for the month of January, 1938:

. . . . *And now please turn to page 52*

General view of engineroom, showing both Enterprise Diesel engines and their General Electric generators. It will be noticed that both engines are mounted on Korfund Vibro-Dampers.



Fine hull lines enable these new Diesel trawlers to maintain good cruising speed without sacrificing proper stability for trawling.

"KITTIWAKE" and "BITTERN"

First Diesel Beam Trawlers from a Southern Yard

TWO important additions to the famous "Bird Fleet" of the Portland Trawling Company of Boston are the Diesel trawlers *Kittiwake* and *Bittern*. Contrary to previous precdent, both of these vessels were constructed by the Charleston Shipbuilding & Drydock Company in South Carolina and are the first ships of this type to be produced in any yard south of New York.

Fairbanks-Morse supplied a 575 hp. 5 cylinder. two cycle Diesel in each case for main propulsion and a 120 hp. 8 cylinder, four cycle unit as an auxiliary to drive the trawling winch. In addition, each vessel carries a pair of 40 hp. F-M Diesels connected to 25 kw. generators for general service power. Other equipment of interest includes Kingsbury thrust bearings, Alnor pyrometers, Maxim silencers on auxiliary engines and Exide batteries. The Diesel-driven trawling winch generators on the *Kittiwake* and *Bittern* were supplied by the Electro Dynamic Corp. and the Diehl Mfg. Company, respectively.

Principle dimensions of these sister-ships are: Length – 146′ 6″; beam – 25′ 6″; and depth – 14′ 6″. Each vessel carries a crew of twenty-two to twenty-six men and has a loaded capacity of 300,000 pounds of fish. All fish holds are thoroughly insulated with nine-inch cork sheathing mounted on two and one-half-inch cypress for minimum refrigeration expense.

Designed speed loaded is 11½ knots with a top speed light of about 13½ knots. Actual operation of the *Kittiwake* since February of this year has proven entirely satisfactory in every respect as indicated by her eminently successful trial trip. Since these vessels are the first of this fleet to be Diesel powered, their records will be watched carefully.

The "Kittiwake" on her trial run in the Cooper River. Trawling trials, held later 15 miles at sea, were successful from a drag standpoint but produced few fish from those waters where they do not run so deep.

ONE CHRISTOPHER STREET

The Story of a Diesel-Electric Plant.

By B. J. VON BONGART

A MODERN big city apartment house represents not only big business but is also representative of efficient business management. The apartment house known as One Christopher Street, New York City, is neither Gotham's largest nor swankiest multi-domicile, but its Diesel power plant for the generating of electricity may well nigh be considered a model to follow; the author has not found its equal in even the most pretentious apartment abodes.

The generating of electric current by means of Diesel power is neither new nor unusual. But when a small 50 kva., 3 phase, 60 cycle alternator can be induced to maintain a terminal potential of 120 volts, irrespective of whether the demand is 12 or 47 kw., that is news. The generating plant at One Christopher Street does this and, in addition, it maintains a frequency of 60 cycles so that electric clocks will neither lose nor gain time within a month. This is more than a huge public utility seems able to do, since the voltage as supplied by large public installations may vary from 115 to 125 volts, according to demand factors, and may reach momentary peaks of as much as 132 volts.

The power plant at One Christopher Street consists of two Buda 4 cycle, 6 cylinder, 5¼" x 7" Diesels, directly coupled to Star 50 kva., 3 phase, 60 cycle alternators, 208/120 volts at 720 rpm., with a power factor of 0.8: the plant layout is shown in Fig. 2.

The two engines shown operate alternatingly, furnishing A.C. current for lighting purposes. Each engine operates for a period of 100 hours at a time. the service being full automatic, not requiring any attention. When engine No. 1 has completed a service-run of 100 hours, engine No. 2 is set in operation manually by means of an electric starter, and then engine No. 1 is shut down for a stand-by period. There is no engineer nor attendant on duty, the engines being equipped with full-automatic temperature controls which allow the cooling water a temperature of 150° to 160° F., but these controls operate a warning system, i.e., blow a horn, when the water temperature reaches 180° F. and they automatically shut down the engine should the water temperature reach 200° F. The oil-pressure controls allow a pressure of 30 lbs. per square inch for the lubricating system, and they, too, operate a horn when the oil pressure drops to but 20 lbs., and they also stop the engine completely should the oil pressure fall to but 5 lbs. pressure. The apparatus is pictured at "B" in Fig. 3.

Mr. Eugene Silber of the One Christopher Street Corporation stated: "At first we had some difficulties, principally too great a variation in voltage, hence flickering light."

This prompted the installation of a voltage stabilizer, shown in Fig. 3. It consists essentially of a solenoid which comes into action instantly whenever a sudden load is demanded from the generator. The solenoid operates a draw-bar which actuates the fuel pump, increasing the fuel supplied and thus speeding up the engine, preventing a drop in terminal voltage which otherwise would be bound to occur. The stabilizer is shown at"A," Fig. 3.

The control-board of the plant, shown in Fig. 4, is of classic simplicity, yet containing all of the instruments needed for the satisfactory operation of a generating plant. The board contains: A recording wattmeter, a kw. demand meter, a power factor indicator, syncroscope and also the usual A.C. volt- and ammeters, a D.C. voltmeter for the fields, together with time-clocks, field rheostats, thumb terminals, etc.

As stated previously, there is no attendant in charge at this plant, as it would be a needless expenditure. Aside from the complete graphs of the recording wattmeter, a log is kept at One Christopher Street; readings from the control board being taken (while visits to the plant are made) every 3 hours, day and night. The log is kept by anyone of the house-staff who happens to be on duty, and while the keeping of the log could be dispensed with, such peep-in visits as are necessitated by the keeping of a log, serve well indeed as a check-up in general.

Mr. Silber further stated: "Having solved the uniform voltage delivery, our next problem was to maintain uniformly a 60 cycle frequency." Now for ordinary lighting purposes, a few cycles more or less than the optimum 60 is neither noticeable nor of any consequence whatsoever, except that electric clocks are extremely sensitive to frequency variations. And pray, of what earthly use is a clock that jumps ahead in fits or drowsily lags behind observatory time? Considerations such as these prompted the installation of a "frequency balancer," which is indicated by F.B. in Fig. 5. This device regulates the frequency to 60 cycles, and hence the electric clocks at One Christopher Street are "on time."

Apartment house dwellers are supplied with free hot-water service as a matter of course,

Fig. 1. One Christopher Street.

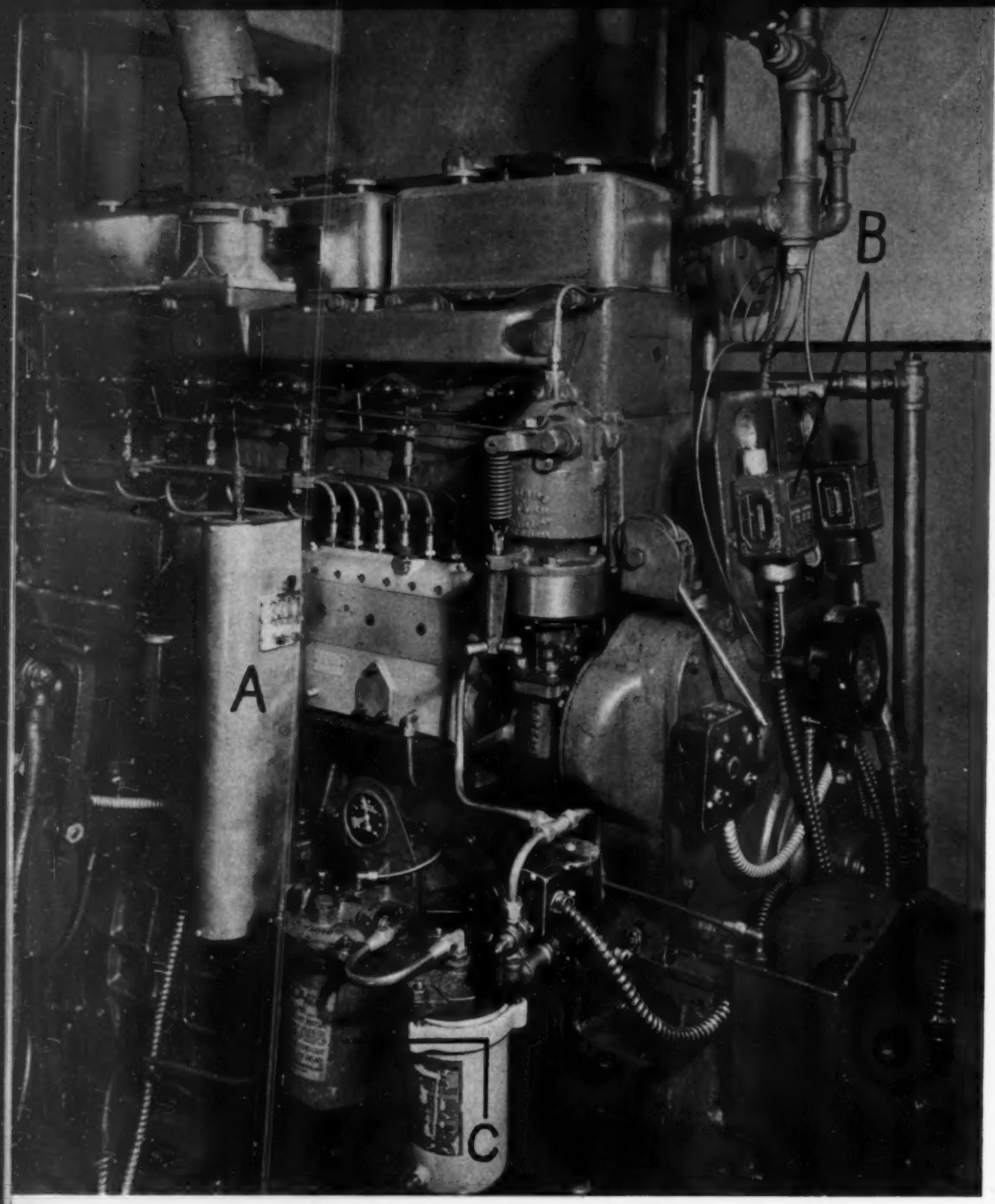


Fig. 3. View of engine controls.
("C" – dual oil filters connected in series.)

yet furnishing an abundant supply to no less than 132 apartments and 5 stores is not exactly a trivial affair. Before the Diesel-electric plant was installed at One Christopher Street, the hot-water boilers required 2,000 gallons of fuel oil for heating purposes per month, a very considerable expense, not to speak of the oil storage facilities required, the attention needed and the complications involved. Today, hot water is produced at this apartment house at no cost whatsoever, the cooling water of the Diesel engines furnishing this hot water, which is forced into storage tanks by means of a pump directly coupled to an electric motor. The latter is started and stopped automatically, pumping when and as required by service demands. See Fig. 6.

Among the free services rendered to apartment dwellers, those of laundry facilities are one of major proportions. This service requires not only washing facilities but also accommodations for the drying of clothes. At One Christopher Street a number of "dryers" were heated with public service gas, consuming 30,000 cu. ft. of gas per month. Since the installation of the Diesel-electric plant, the exhaust pipes of the engines, being equipped with air-heaters, are thus supplying 5,000 cu. ft. of warm air per minute, more than sufficient for all drying purposes. And such services are now not only cost-free (no gas needed for heating) but are far superior from a health standpoint. The hot air emanating from over an open gas flame is not pure air, since it contains not only CO_2 (harmless but annoying) but also quantities of CO, which is decidedly harmful even while not always suffocating. The warm air as supplied now is *pure* air, containing neither carbon dioxide nor carbonic oxide.

Fig. 4. Control panel layout.

A demand of 20,000 kw. per month is made upon the plant, and the output in electricity is at the rate of 10.2 kw. per gallon of fuel oil consumed. From 16 to 17 gallons of lubricating oil are used per month. Electricity is thus produced at a cost of but a fraction of a cent per kw. hour, and in addition huge savings are made possible by eliminating expenses for gas water heating, clothes drying, etc. The plant has been in continuous trouble-free operation for nine months, and Mr. Silber states that the plant will pay for itself in but three years. The reliability of the Diesel-electric plant is such that no tie-in for stand-by services with the public utility is provided for; the owners of One Christopher Street are convinced that their plant needs not to lean on outside reserves. The elevators at the above building are, for the time being at least, operated with current finished by the utility company. However, there is sufficient space (see Fig. 2) for the installation of a third unit (which may be mounted later), and this would divorce the building entirely from all outside power and light sources.

Thus far, the plant operated without interruption for over 7,000 hours. Mr. Silber ascribes the trouble-free operation in part to the low speed (720 rpm.) of the engines, but also to the low compression ratio of the Buda Diesels, which is but 12½:1, thanks to the Lanova-system of combustion chamber construction as used for Buda Diesels.

The light service to the 132 apartments and stores is distributed over the 3 phases, and the load is thus balanced to the greatest possible extent. However, the demand for electricity is bound to vary considerably among such a great number of households; not all tenants operate electric toasters for breakfast, or turn on the

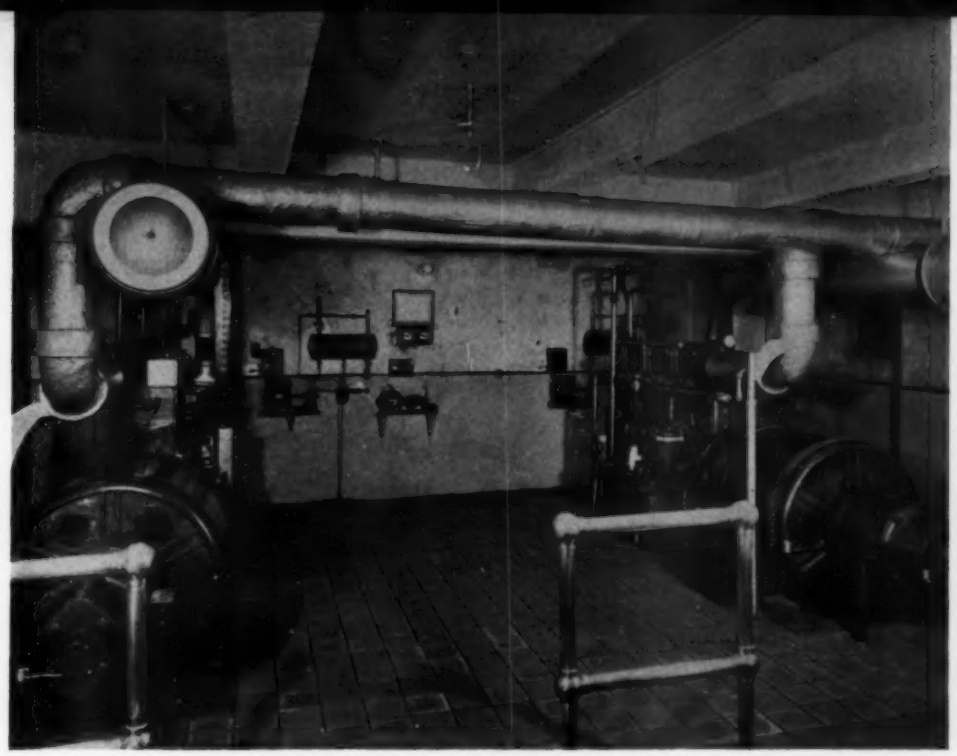


Fig. 2. Power plant, Buda engines, Star alternators.

radio simultaneously, nor vacuum clean their apartments in unison. If the load were exclusively one of incandescent lamps, the power factor would be (theoretically) unity. But there exists a comparatively large intermittent inductive load by virtue of some 140 electric refrigerators, aside from vacuum-cleaner motors. Yet, in spite of it all, a power factor of 0.70 to 0.92 can be maintained here.

The maintenance of a potential never wavering below nor above 120 volts is a particular item in this installation, for, as Mr. Silber stated: "When we sub-metered current furnished by the New York utility company the mortality of electric light bulbs totaled an expense of approximately $30 per month, this being due to voltage rises, whereas now, with our own current supply, our monthly bill for burned out bulbs does not exceed $7, which is quite a saving."

Aside from the inherent efficiency of the Diesel engine, the plant at One Christopher Street makes use of heat values all too often wasted, thus increasing the total efficiency of the installation as a whole. The hot-water supply, the furnishing of warm air for drying purposes are all based upon the heat produced by the Diesel engine. Mr. Silber calculates that the installation utilizes fully 85 per cent of the total heat value of the fuel oil burned. The heat still liberated via the smokestack could perhaps be made to perform still further tasks if it were not for the fact that too complete a cooling of the exhaust gases would perhaps give rise to condensations, which, in plants such as the above, are unwanted for various reasons.

However, here is one suggestion: Apartment houses equipped with air conditioning could readily use the Diesel engine's exhaust gases for the production of "dry ice" – the latter is essentially but CO_2 – which would indeed be useful to cool the summer's hot air and bring comfort to the tenants. Cooling the air by dry ice is far superior to the usual method of wet-refrigeration.

Apartments are rented on a strictly competitive basis and today's tenants demand satisfactory services, even if they are furnished gratis – which in so far as light is concerned does not apply here, since electricity is sold to the tenants – thus when a small individually operated Diesel-electric plant can out-perform a huge public utility in every respect, then such installations are bound to increase in ever greater numbers.

In summarizing, it may be said, that such queries as: "Can a small Diesel-electric plant successfully compete with a public utility on a current-cost basis? Can a private plant furnish electricity of commercial uniformity as to voltage and frequency? Can a small plant boast unfailing performance when compared with huge utilities? Can a small private plant produce worth-while revenue for its owners and operators?" are answered in fullest detail in the above simple story of One Christopher Street, New York, N. Y.

The Automatic Diesel Electric Co. were the designers of this plant, and it was installed by Eugene Silber.

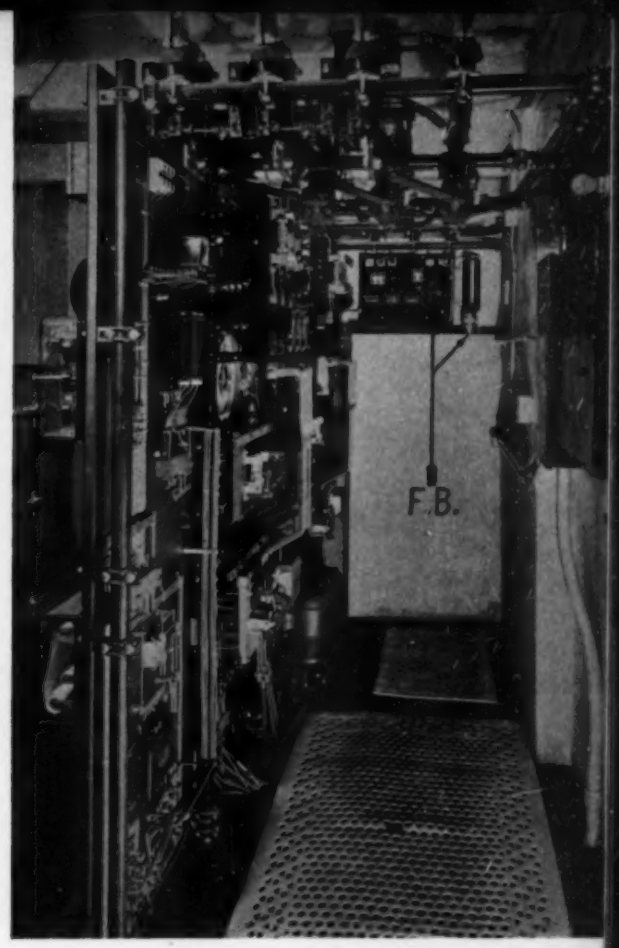


Fig. 5. A peep behind the control panel, showing the "frequency balancer."

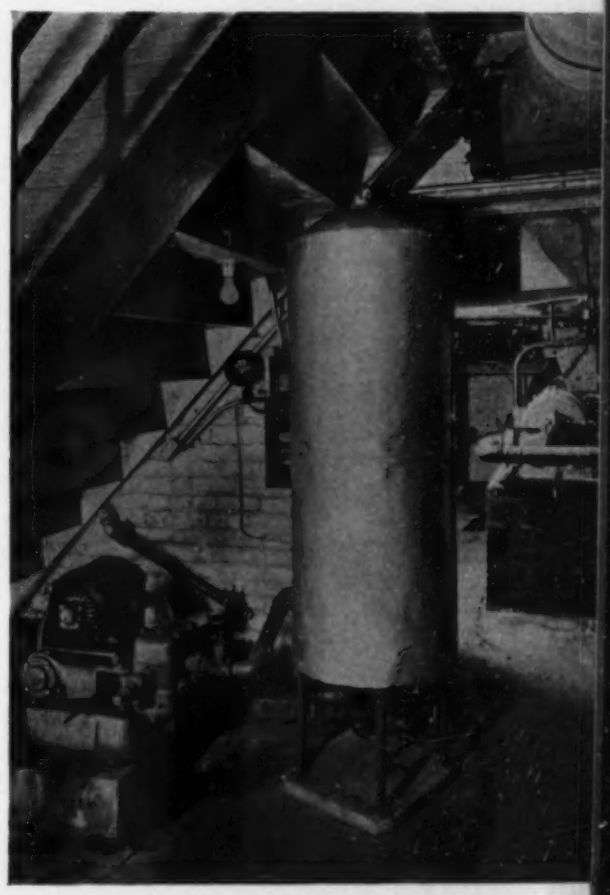
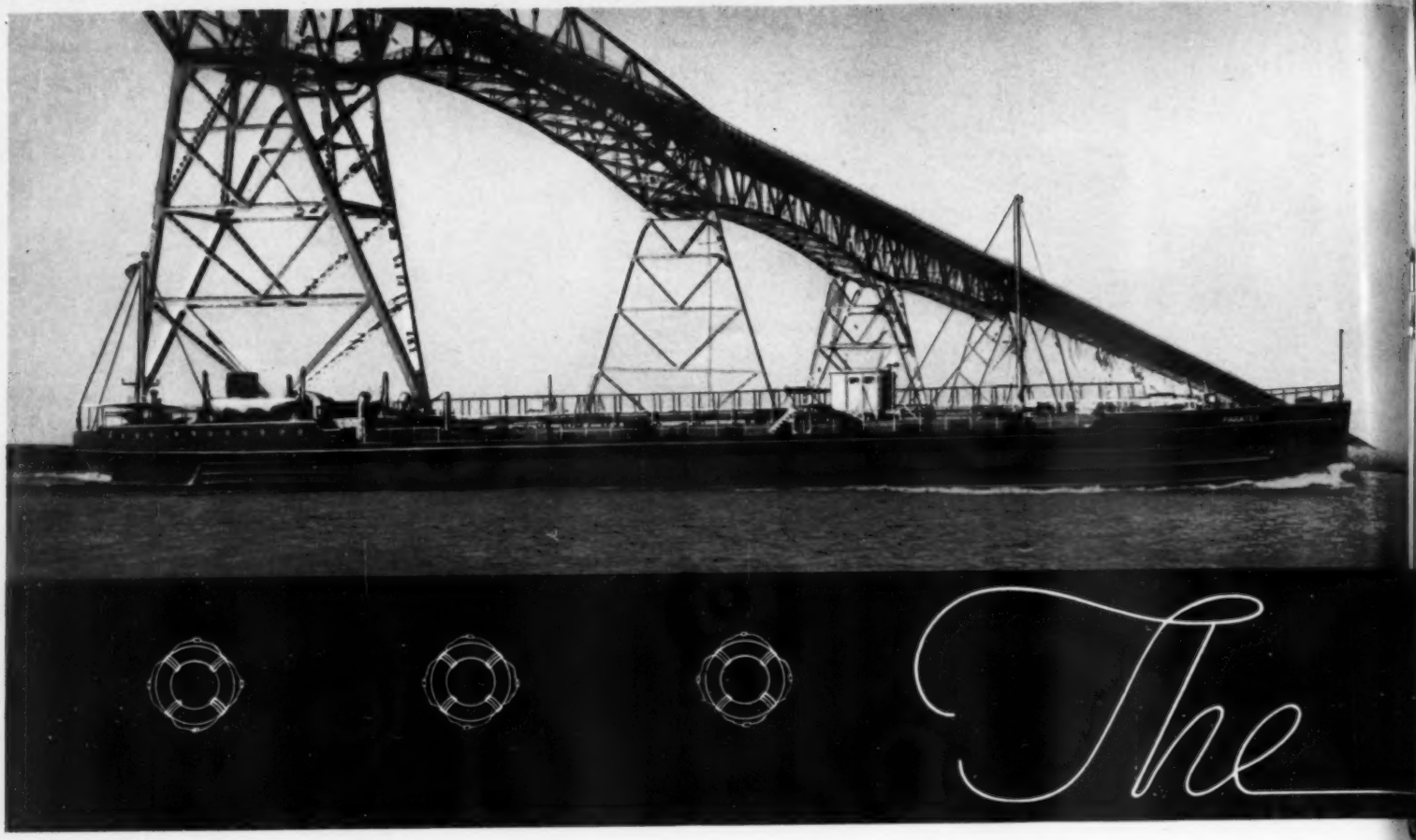


Fig. 6. Electrically driven hot-water pumps.



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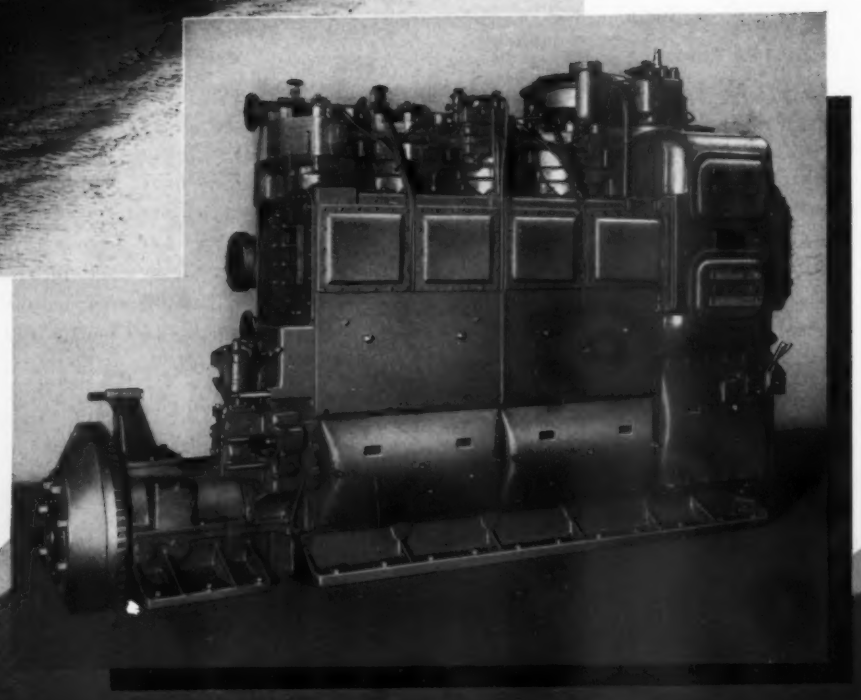


"PARATEX"

The "Paratex", outstanding latest addition to the American tanker fleet, was built for the Gulf Oil Corporation by the Pennsylvania Shipyards, Inc.

This ship embodies the simplest and most efficient machinery arrangement.

The two, 4-cylinder, 2-cycle, trunk piston Alco-Sulzer Diesel engines, which are used as main propelling units, have amply demonstrated their reliable and economical operation.

Alco

DIESEL ENGINE DIVISION

AMERICAN LOCOMOTIVE COMPANY

30 CHURCH STREET, NEW YORK CITY

DENTON, TEXAS

By ORVILLE ADAMS

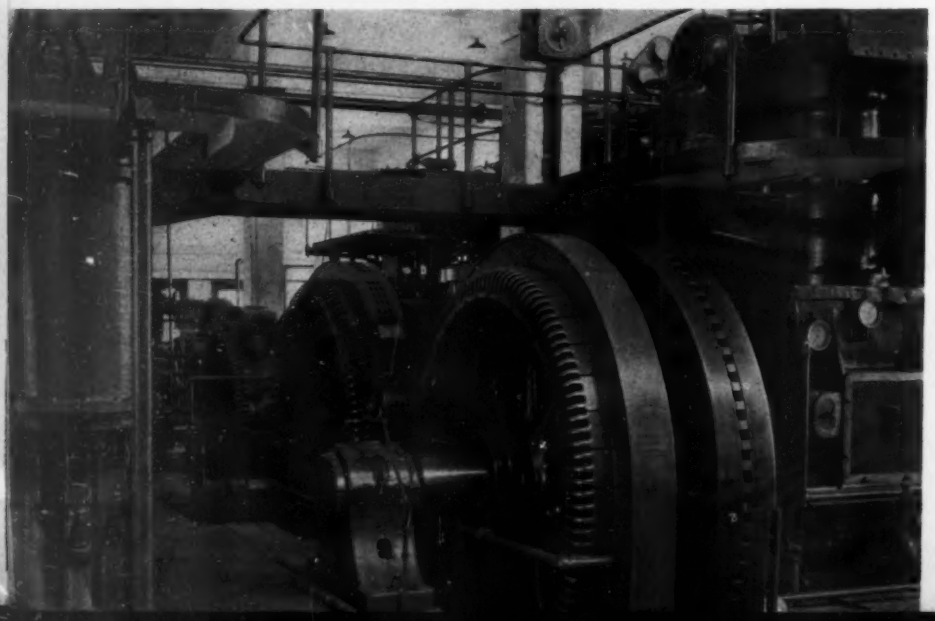
WHEN Denton, Texas, installed two 1,000 hp. Diesel engines in 1937, it completed the Dieselization of its Municipal Light and Water plant and became the outstanding Diesel power plant in this section. Twenty years ago the steam plant was one of the best of that day. During the next ten years, natural gas engines replaced the steam plant, until a total of 1,700 hp. was installed, and earned an enviable record for economy for that type of engine. With the growth of the load and the possibility for even greater economy of operation, the gas engines were gradually replaced by Diesels, commencing in 1930 with an 800 hp. McIntosh & Seymour air injection engine, followed in 1933 by the second McIntosh & Seymour engine of 1,000 hp., and a DeLaVergne 1,000 hp. engine in 1936, which replaced the last of the gas engines. At this time, an entirely new building was constructed with provisions for two more engines of the same size. Accordingly in 1937, the city purchased a 1,000 hp. McIntosh & Seymour and a 1,000 hp. DeLaVergne, both the latest type solid injection engines. Only one small gas engine remains in the plant for driving an air compressor and emergency lighting system.

The Denton plant is one of the best equipped in the country. Each engine has a full complement of auxiliaries, adequate in size and properly installed. All five units are fitted with American air filters. Exhaust silencers on three of the engines were furnished by Maxim, one by Burgess and one by DeLaVergne. Exhaust temperatures are recorded by three Brown pyrometers and two Alnors. There are four lubricating oil centrifuges, all supplied by DeLaval, and Double Seal piston rings are used throughout. Two General Electric and three Westinghouse generators complete the list of principle auxiliary equipment. A complete operating, maintenance and repair record is kept of each engine, which has its own air filter, pyrometer, centrifuge, fuel and lubricating oil filters, oil coolers, etc. Totallizing watt-hour meters on the switchboard check the output against fuel, lubricating oil and other operating expenses. The design and installation of the accessories represent the best in today's Diesel practice. It is not surprising therefore to find that the plant is earning for its citizens well over $100,000.00 a year, over and above all operating cost, and this does not include a large profit from the water plant and other city utilities which are powered by this plant. The output in 1937 was 7,248,000 kw.-hrs. The complete cost of the entire light department, including distribution and maintenance was $44,832.18, which deducted from $146,661.87 gross sales, gives a profit of $101,-829.69.

The plant has just purchased an oil purifier from the Youngstown-Miller Company, which will be used to reclaim by batch purification the crankcase oil at regular intervals. The general practice is to centrifuge the oil from each engine continuously through a DeLaval machine, each engine having its individual centrifuge running while the engine is in operation.

An operating cost figure of approximately .008934 mills, per kilowatt hour at the switchboard is estimated which includes fuel oil at .00259 mills, lubricating oil at .00059 mills, labor at .00122, together with repair, maintenance, interest and depreciation.

The city has a large per capita consumption of water and light and power, the population being above 10,000 with a student population of the two state colleges of approximately 5,000. While these two institutions are state supported, they obtain a large part of their utilities from the city plant. Denton is a tax-free town, as far as general expenses of the government are concerned, and uses the profit from its utilities for the operation of all other departments of its government, maintenance



Two Westinghouse generators in the foreground and one General Electric generator in the background — Denton, Texas, municipal Diesel plant.

of the street lights, city buildings, streets, and administrative departments.

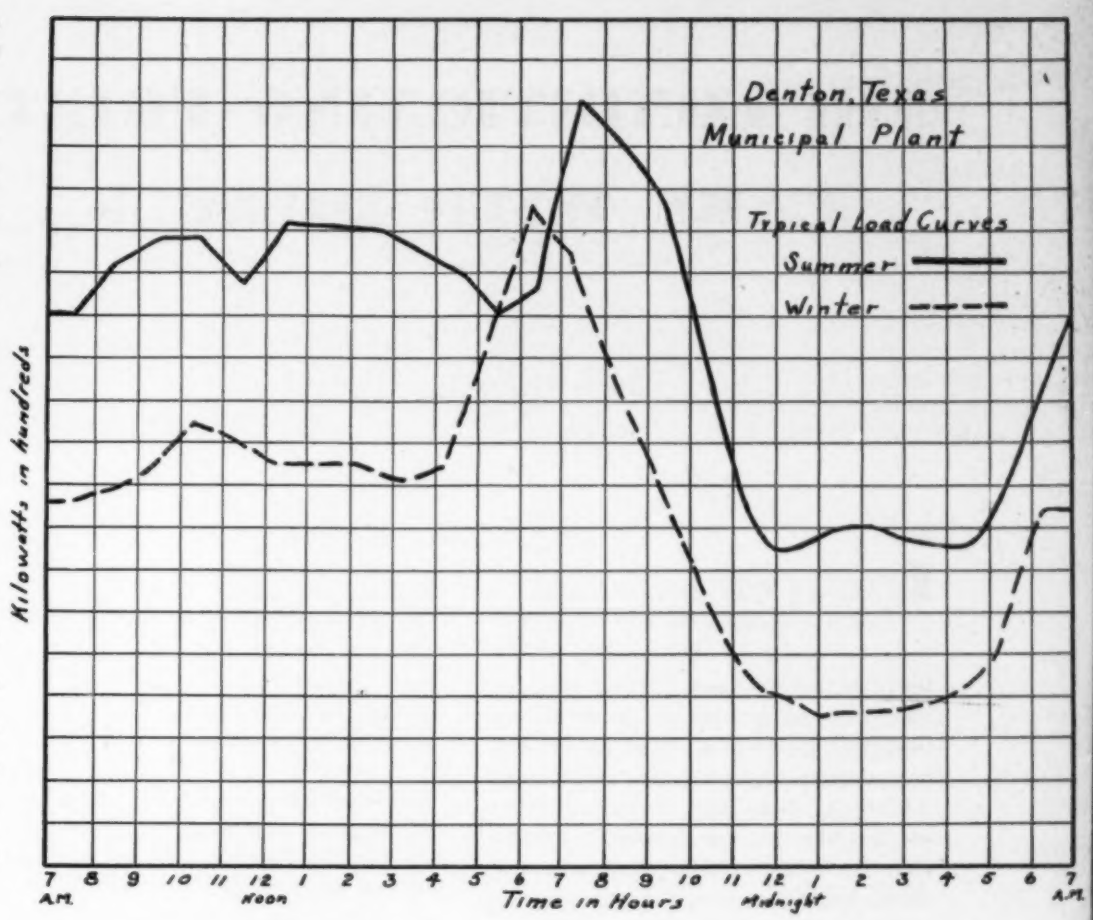
An unusually high tax rate as well as a very high assessment would be necessary to raise the amount of money which Denton's utilities earn, a sum amounting to considerably more than $100 per capita. As pointed out by one of the city officials, the increasing demand for power, light and water, and the decreasing overhead and operating cost will continue to increase the net profit on the capital investment, until the utilities will show the greatest net earnings per capita of any town in the state. This money will continue to be applied toward improving and beautifying the city. Moreover, the rates are already about as low as any town of this size in the state having its own municipal plant.

The maintenance of the Denton engines has been the chief concern of Mr. Cartwright. The Diesels are given regular inspection, bearing and liner wear checked, and every effort to reduce wear has been made. The records for the 800 hp. McIntosh & Seymour engine which has now been in operation nearly nine years show 48,345 operating hours, with a cylinder liner wear of only about 65 thousandths (.065) average. A check made three years ago of liner wear against hours of operation indicated that the liners had worn about .040 on an average for the first thirty thousand engine hours, or approximately 0.0013 inches per thousand hours of operation. At that time, Double Seal rings were installed. The rate of wear was reduced to .001" per 1,000 hours of operation, the fuel economy improved approximately 1½ kilowatt hours per gallon of fuel, and lubricating oil consumption decreased approximately one third. The Double Seal rings have operated about 18,000 hours.

With the installation of the new Y-M Oil Purifier, it is said that the oil which is drained from the circulating system and wasted each year, amounting to around 1,800 gallons, may be reclaimed completely and kept in the system. The removal of the fuel dilution, acids, water, free carbon, colloidal sludge, and other products of oxidation that contaminate the circulating oil will be effected by this purifier. This will restore the oil to its original condition of service, and result in economy and further safety from stuck rings.

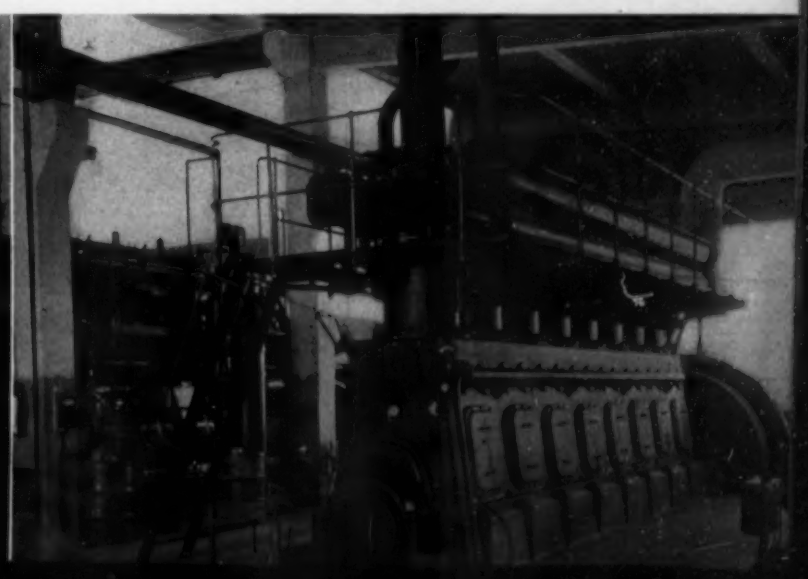
Stuck rings in this engine have been eliminated and ring replacement is a matter of one or two rings per year instead of a set of rings.

The repair and maintenance cost in the plant is as low as the best, and a competent corps of operators under Mr. Cartwright take great pride in their work. The low fuel cost made possible by low grades of fuel is not considered the chief factor of Diesel economy in this plant. Reduced maintenance cost, lower repair bills, and longer life of the engine parts rank as primary considerations in obtaining the ultimate economy, and not fuel cost per gallon. These facts are impressed upon the operating engineers, that the final economy is influenced by the number of years a liner can be used, the greatest kilowatts per gallon of fuel, the best possible lubricating efficiency. A well equipped machine shop has been found to be a worthwhile complement of this plant. The result has been that major repairs, and avoidable breakdowns have not occurred. The plant has never been off the line, and the people are highly gratified with the service.



The two 1000 hp. McIntosh & Seymour Diesel engines started in Summer of 1937.

The first 1,000 hp. De La Vergne engine installed in Denton plant — one of the four De Laval separators in the lower right corner.



AIR CONDITIONING FRUIT CARS WITH DIESELS

By JOHN R. WEST

IF you were to ask ten people, "Where is air conditioning equipment used by the railroads?" the chances are that all ten would answer, "In passenger and sleeping cars." It would be a safe bet that no one would mention, far less know, that fruit, vegetable and meat carrying freight cars were users of air conditioning long before the first passenger car. Yet when you stop to analyze it, refrigerated cars for perishable goods have been in service for well over a third of a century — and a crude form of air conditioning was what made possible the movement of perishables over long distances.

From the very beginning ice has been the mainstay for pre-cooling cars as well as for maintaining low temperatures in transit. Many experimental cars have been built with small refrigerating plants housed in one end of the car — but ice still stands as the accepted method of maintaining a cool temperature during movement.

Probably few persons, except those in the produce, meat packing or railroad industry, realize that equally as important as maintaining a low temperature during transit is the problem of pre-cooling the car *before* it is started on its journey.

It is this problem of pre-cooling that has been the subject of considerable research during recent years, and from this research and experimenting has now come a new method that may revolutionize previous systems of car pre-cooling. One individual who is due credit for thoroughly studying this problem, and then doing something about it, is Harry Y. Stebbins, vice president of the General American Precooling Corp. It was over three years ago that his firm put into service a mechanical pre-cooling plant, built from his designs.

These early pre-coolers were designed to shorten the time required to remove the field heat from a car that might have been standing on a siding under a blistering sun for a few hours or a week. Ordinarily ice would be loaded into the car and from 36 to 72 hours would be needed to lower the car's temperature to a point where loading could be safely accomplished. The plant designed by Stebbins consisted of an electrically driven refrigeration compressor plant mounted on an ordinary truck type of trailer. The trailer would be spotted beside the open doors of the car to be cooled, and the plant started up. A large canvas shroud would be placed over the opening in the car, and fans would circulate the air in the car through refrigeration coils. This system tremendously reduced the time required in pre-cooling — and was superior to the old methods of icing a car.

After the car was loaded with fruit, the trailer carrying the refrigerating plant would again be brought alongside. Additional cooling would be given the loaded car until the correct temperature was reached.

Fig. 1 — The 85 hp. Cummins Diesel. To the left, the Vilters V-belt driven compressor.

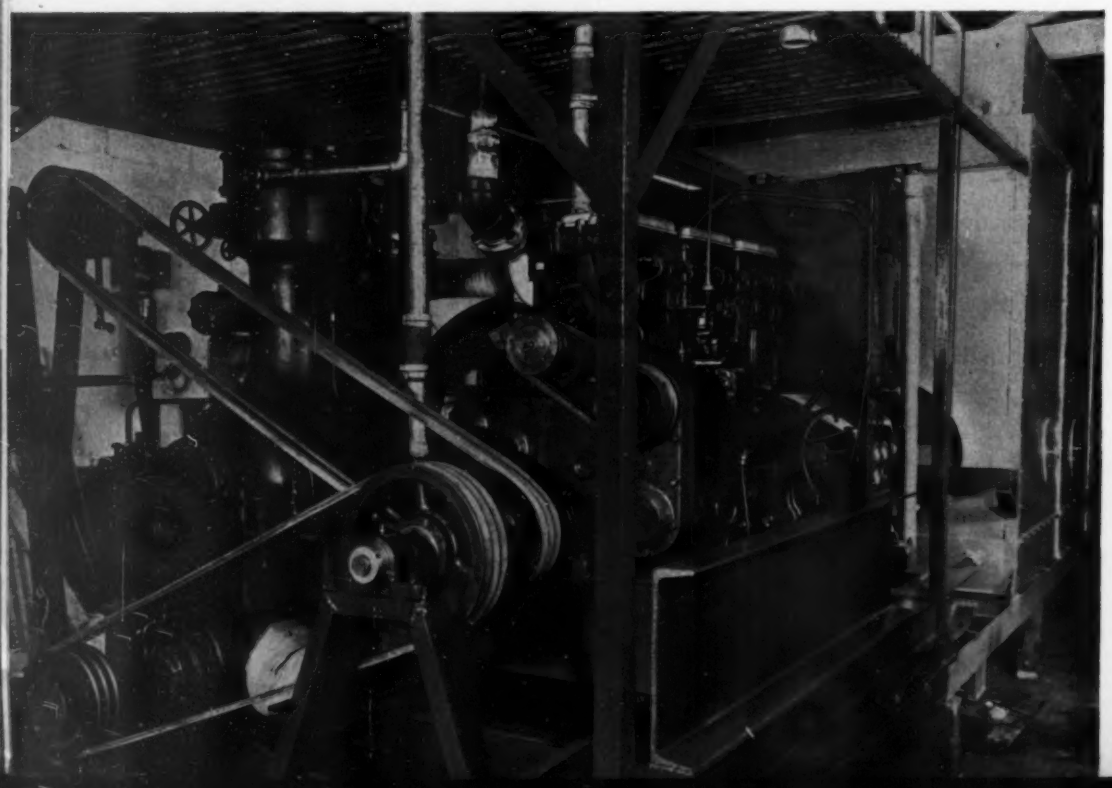


Fig. 6 – Seven of a group of nine fruit cars being cooled by the Cummins Diesel powered compressor plants.

The next step forward in pre-cooling plants was a plant built by General American Precooling, using the Ford truck engines to drive the compressors. A year later a larger type plant was built, with the refrigeration equipment mounted on a truck, and powered with larger gasoline engines. The success of these units prompted the building of even larger units that could pre-cool a number of cars at one time. Up to this time it required a complete plant for each car to be cooled.

It was in late 1936 that the first Diesel powered plant was built. Since then a number have been put in service and a production program is now being started. Essentially all of the Diesel units to date are the same. On a welded structural steel base, about the size of an average truck trailer, is mounted the entire self-contained refrigeration equipment consisting of the Cummins Diesel, compressor, condenser, brine tanks and circulating pumps.

Reference to Figure 1 shows, on the right, the Cummins Diesel rated at 85 hp. when turning 1,200 rpm. These engines are of the full Diesel, cold starting type, equipped with a 24 volt electric starting system. Cummins Diesels of this same general type power thousands of trucks, industrial plants and boats throughout America. On the front of the engine is a short shaft on which two Vee belt pulleys are mounted. The belt going downward drives the 500 gpm. brine circulating pump, while the upper belt drives a line shaft used to operate an air circulating fan. (The fan is installed only when the plant is to be operated in a cold storage warehouse and is not needed for produce car pre-cooling.) In the left foreground is the Vilters compressor that is Vee belt driven through the clutch power take-off of the Cummins Diesel.

Figure 2 shows a close-up of the compressor drive. The Diesel is set for 1,200 rpm., which gives a speed of 325 rpm. on the compressor. A line shaft extends from the shaft that carries the compressor driving pulley and on this line shaft are the circulating fans located in each end of the General American high velocity condenser. One of the fans is shown in Figure 3, which also shows the ends of the condenser and the brine tank. This same shaft drives the 200 gpm. condenser pump through chain and sprockets. Figure 4 shows the brine tank side and, at the extreme far end, the compressor.

The entire plant is partially enclosed with sheet metal to protect it from weather. When in service this unit is transported to the railroad siding where the cars are to be loaded. The balance of the equipment needed consists of six small structures in which are located the heat exchange equipment and their electrically driven air circulating fans.

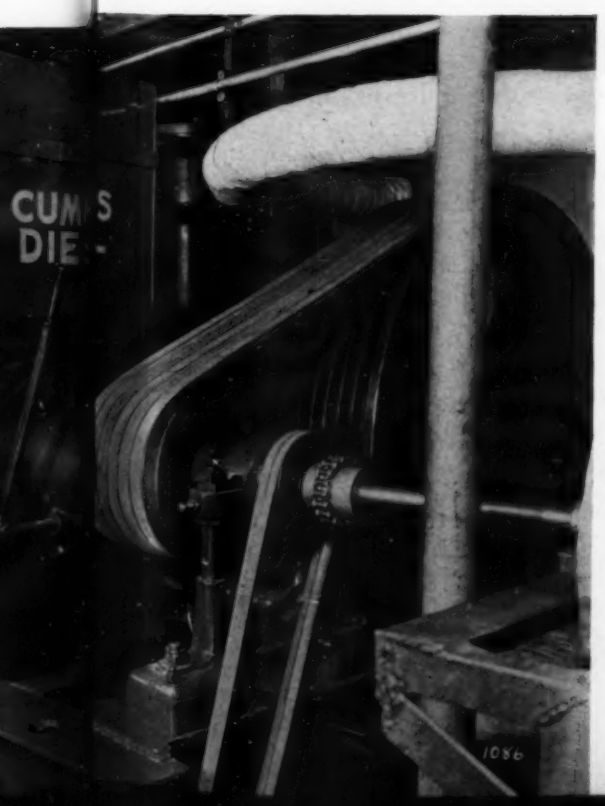


Fig. 2 – A close-up of the compressor drive.

All six cooling-structures are piped in series, and in this manner six produce cars can be cooled at one time, from the single compressor plant. Figure 5 shows a typical set-up of compressor and in the immediate background, one of the six cooling-coil structures served by the compressor plant. Canvas shrouds that completely enclose the car doors extend from the cooling-structures to the sides of the produce cars. These cooling units are so built that the air in the car is drawn through the cooling medium, and returned to the car once every two seconds. The fans in the cooling-structures are driven by a five hp. electric motor. At the same time the air is being cooled it is also washed and humidified. In this manner the true and complete fundamentals of air conditioning take place—namely: cooling, circulating, washing, and humidifying.

Shown in Figure 6 are seven of a string of nine fruit cars being cooled. As will be noted there are two of the Cummins Diesel powered compressor plants side by side, which serve nine cooling-structures.

Harry Stebbins of General American Precooling states that cooling fruit cars with these Cummins Diesel powered plants has reduced fuel costs per car to about one-fourth the cost of using gasoline powered units, and to about half the cost of Butane powered units. Being able to cool six cars at one time has reduced maintenance expenses, stocks of spare parts, and the number of men required to operate the equipment. As an example of the speed with which fruit cars can be cooled is the fact that a car loaded with grapes or plums can be brought down to about 39°F in six hours – and strawberries in about two hours. This compares to about 72 hours and 36 hours respectively when ice alone is used. Another factor

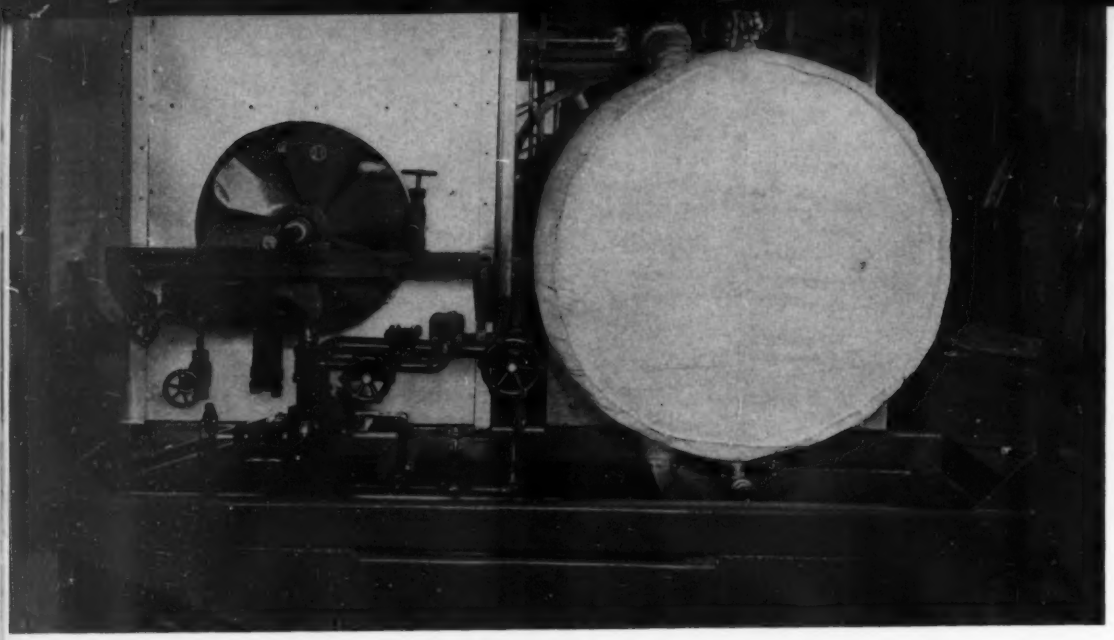


Fig. 3 — Left end view showing circulating fan, brine tank and General American condenser.

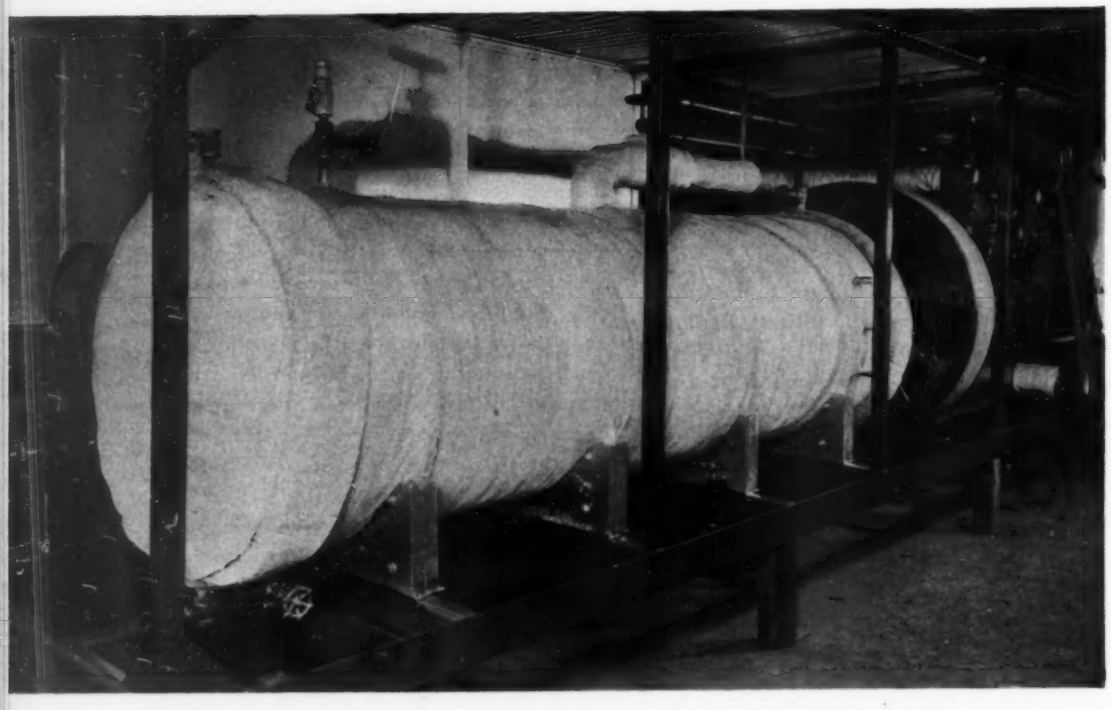


Fig. 4 — Front view, showing brine tank side and compressor at extreme right.

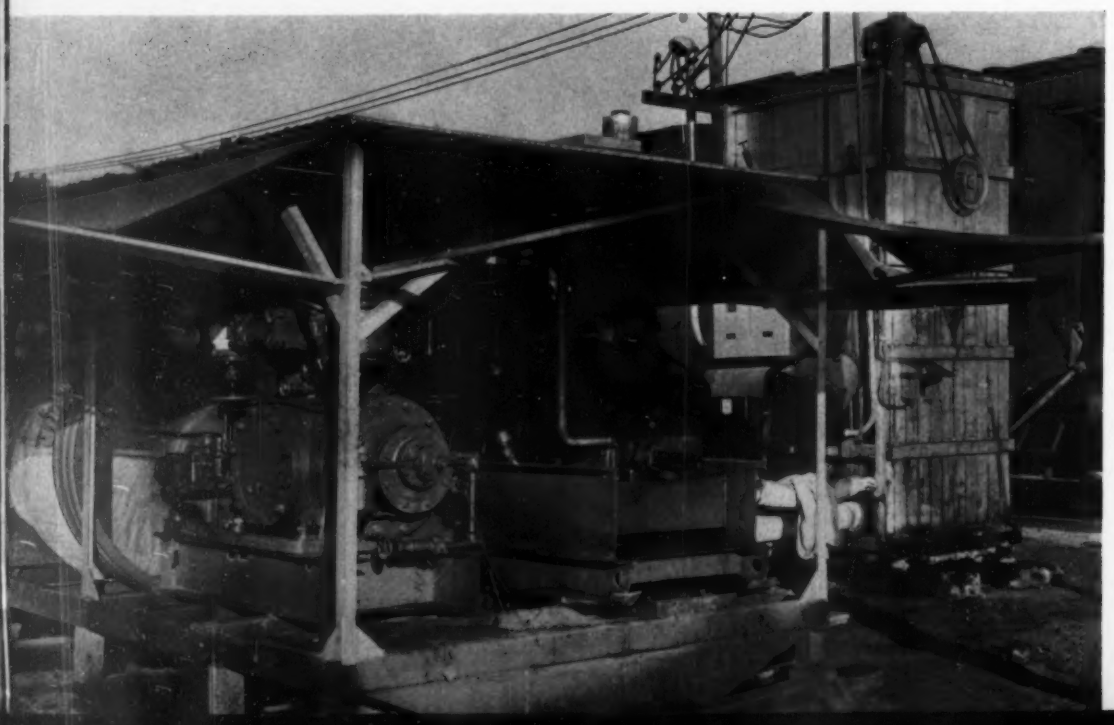


Fig. 5 — Typical set-up of compressor. In the immediate background can be seen one of six cooling-coil structures served by the compressor plant.

of tremendous importance is that the temperatures on various tiers of fruit, at various places in the cars, and even in the centers of the crates, are fairly uniform. This is difficult to attain with any other cooling system due to the lack of adequate air circulation with other methods, and it is one of the most vital factors in the safe arrival of the goods at the destination.

Each year the railroads pay many millions of dollars in freight claims on fruit shipments that have spoiled during transit. A large proportion of the spoilage is directly traceable to insufficient precooling, or to uneven cooling. This expense to the railroads can be almost entirely eliminated with this new method of precooling. There are many sections in the country where cars must be loaded under extremely adverse conditions, such as high summer temperatures or low humidity. These modern Diesel-powered units are demonstrating that they are able to meet the most rigorous conditions.

A number of these plants are in operation in Southern California, two have been shipped to Texas, and orders are already placed for units to go to major fruit and vegetable shipping centers. Thus the continuous research by engineers has brought air conditioning into another field where it has long been needed, and where the high efficiency of the Diesel engine can be capitalized upon.

A secondary market that is rapidly opening for the car precooling plants is among cooperative and private cold storage plants where seasonal conditions do not justify a permanently installed refrigeration plant. An example is to be found in the fruit producing sections of the country where crops progressively become ready for storage or shipment. The General American Precooling Corporation's development is a self-contained plant that can be moved from one section to another, thus following the crops as they are harvested.

Another interesting application is the use of these plants by the motion picture industry for cooling their large sound stages and other buildings, during the summertime, or when large casts and extensive lighting raise the normal temperatures to the uncomfortable point.

ANALYSIS OF BEARING LOADS

By J. G. WILLIAMS

WITH the gradual improvement in fuel oil, injection equipment and engineering materials in general, there has been a growing tendency toward higher speeds in the Diesel engine field. Among the chief limitations to high speeds is the durability of the bearings under the larger loads imposed by the increased inertia forces of the unbalanced rotating and reciprocating parts. In the past, bearing design was based upon experiment and experience, particularly in the slow speed engine field, where all parts were designed most conservatively. However, in the modern high speed Diesel engine, the factor of safety must be small in order to obtain the maximum horsepower per unit of weight and, therefore, it is obviously necessary to know definitely the maximum operating load and the maximum permissible limits of the bearing pressures. Although many criterions have been devised to determine the durability of bearings, the most common and probably the most reliable measures are the average pressure, the maximum pressure and the PV value (average pressure times mean rubbing speed). Despite the fact that the methods of calculating these three quantities is not new, only a few designers are using them to analyze bearing problems logically. By demonstrating the method of calculating these three criterions of bearing life, it is the purpose of this article to show how much of the "guess-work" of bearing design can be eliminated.

In any engine the resultant load on the bearings is the vectorial sum of the gas forces and inertia forces from unbalanced reciprocating and rotating parts. By averaging the resultant forces at small increments of ten or fifteen degrees, for example, through one complete cycle the mean load on any bearing can be obtained. If certain assumptions are made, the calculations can be simplified greatly and the mental labor involved will be reduced proportionally. First, it is assumed that the connecting rod can be divided into equivalent rotating and reciprocating parts. After the center of gravity of the connecting rod is accurately located, the equivalent reciprocating and rotating portions can be calculated by the following equations:

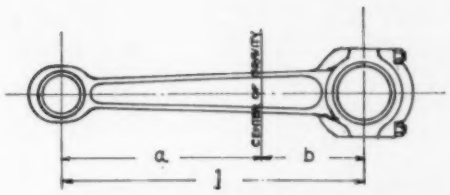


FIG. 1 CONNECTING ROD

W = Weight of connecting rod

(1) Reciprocating weight, $Ws = W\frac{b}{l}$

(2) Rotating weight, $Wr = W\frac{a}{l}$

The rotating weight, Wr, is considered to be acting at the crank radius and the reciprocating portion, Ws, is assumed to act at the piston pin center. Second, in calculating the main bearing loads, it is assumed that the crankshaft has no stiffness. Although some error is introduced by this second assumption, it is done to avoid the use of the laborious "Theorem of Three Moments." Since the crankshaft does have some stiffness, the error is on the safe side. By referring to the sketch below it will be seen how a crankshaft is treated for calculation purposes.

or 360 degrees for a two cycle engine and 720 degrees for a four cycle engine.

Before considering the bearings individually both the reciprocating and rotating inertia forces should be calculated for the speed being studied. The reciprocating weights consist of the piston assembly and the light end of the connecting rod, Ws, of equation (1). For the crankpin bearing the only rotating inertia force comes from the heavy end of the connecting rod, Wr of equation (2). The rotating inertia forces on the main bearing will be discussed in detail later. It is usually convenient at this time to calculate the unbalanced rotating weight at the crank radius for one-half a throw of the crankshaft as in figure 2. The inertia forces resulting from the reciprocating or unbalanced rotating weights can be calculated by substituting in the following formulae. The factor (cos. A $\frac{r}{l}$ cos. 2A) can be found in many text books on the markets listed under the usual $\frac{l}{r}$ ratios.

(3) Fi = .0000284 WiRN (cos. A $\frac{r}{l}$ cos. 2A)

(4) Fc = .0000284 WcRN

Fi = Reciprocating inertia force—pounds

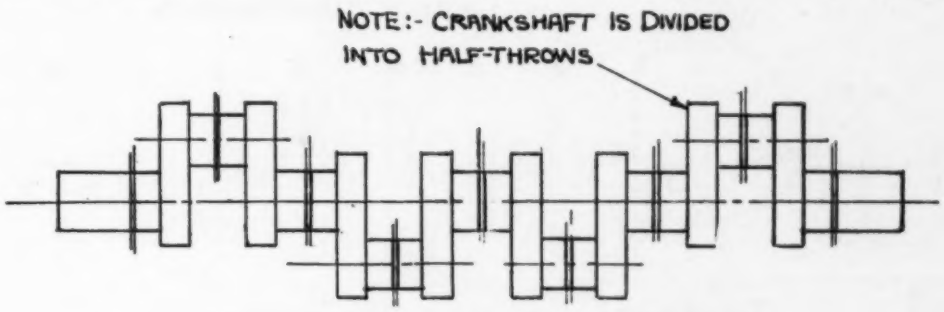


FIG. 2. MATHEMATICAL TREATMENT OF CRANKSHAFTS

With these basic assumptions understood, the average loads can then be determined through the use of polar diagrams as explained in some of the following paragraphs.

Only the piston pin, crankpin and main bearings will be considered in this article. In each case the forces acting in the bearing will be analyzed and the extreme limits for common bearing materials will be mentioned. The average force is for one complete cycle of events

Fc = Rotating centrifugal force—pounds

Wi = Total reciprocating weight—pounds

Wr = Total unbalanced rotating weight—pounds

N = Engine speed—rpm.

R = Crank radius—inches

A = Crank angle of crank throw

r = Crank radius

l = (see figure 1)

The piston pin is subjected to reciprocating

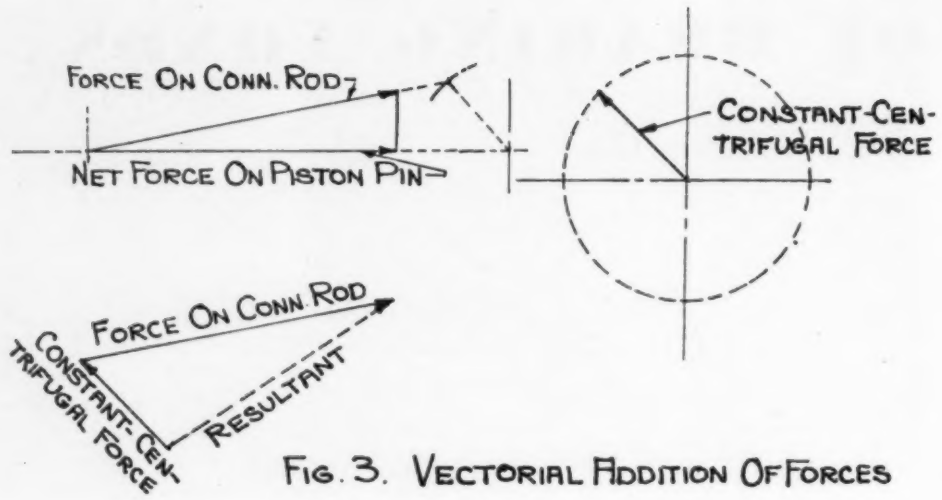


FIG. 3. VECTORIAL ADDITION OF FORCES

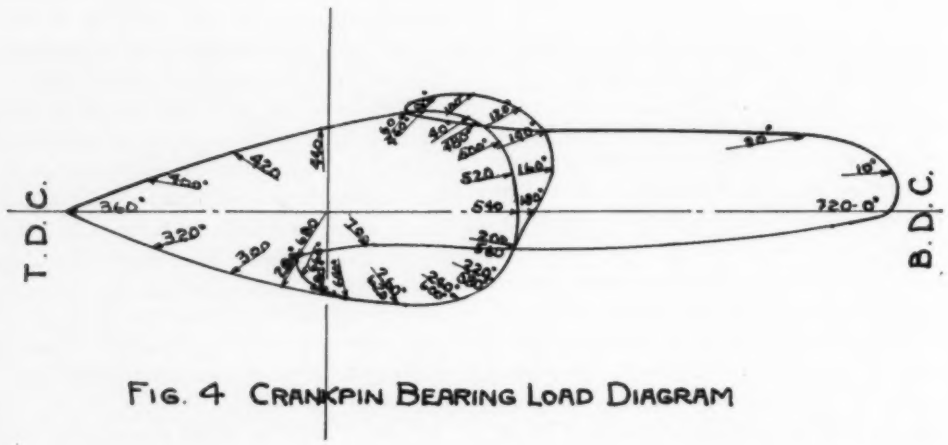
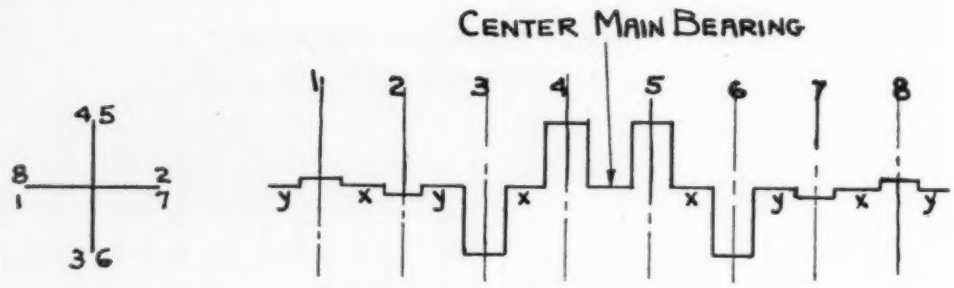


FIG. 4 CRANKPIN BEARING LOAD DIAGRAM



INTERMEDIATE MAIN BEARINGS
LOW LOAD - MARKED "X"
HIGH LOAD - MARKED "y"

FIG. 5. MAIN BEARING LOADS - EIGHT CYL. ENGINE

inertia forces and gas loads. The resultant load at any position of the crankpin can be obtained by adding algebraically the two forces giving proper attention to the direction of each force. It will be found that, except for unusually high speeds, the average resultant force through one cycle will be well below the permissible limits. Also, the PV value means nothing, since the piston pin does not rotate. Therefore, the maximum pressure is the only important criterion upon which to base the design of this bearing. Since the inertia forces are negligibly small at idling speeds, only the maximum gas load need be considered. For the common floating type of piston pin using hard bronze bushings, a maximum unit pressure of about 5,000 pounds per square inch should not be exceeded.

Using the net forces at the piston pin, the result of adding the gas forces and reciprocating inertia forces algebraically, the loads on the crankpin can be determined by vectorially adding this force to the centrifugal force of the heavy end of the connecting rod. The centrifugal force of the heavy end of the connecting rod (which is calculated by substituting in equation 4) is constant and varies in direction radially with the position of the crankpin with respect to the crankshaft center line. The net reciprocating force must be converted to the resultant conecting rod thrust which is then vectorially added to the rotating inertia vector. The procedure is illustrated in Figure 3.

If the above resultant force is plotted for small increments, 10 or 15 degrees for example, a bearing load polar diagram can be constructed. For a four cycle engine it will appear similar to the one shown in Figure 4.

To calculate the average pressure the resultant loads for each increment are totaled, averaged and then divided by the net projected bearing area. The PV value can be determined by multiplying the average pressure and the mean rubbing speed of the bearing journal. The usual units for this later value are pounds per square inch and feet per second. The maximum pressure is the maximum resultant load divided by the net bearing area. Since the bearing materials for the crankpin and main bearings are usually the same, the average and maximum limits for bearing pressures and the PV value will be discussed later after the main bearing pressure calculation methods have been explained.

To calculate the average pressure on the main bearings the same general procedure is used as for the crankpin bearings. Half the forces in each adjacent cylinder and crank throw are added vectorially to determine the resultant force on the bearing. However, certain complications are introduced on account of the fact that in the two cylinders adjacent to any main bearing, the gas pressures on the pistons are different. Also, if the crank throws are not in the same plane, both the reciprocating and rotating inertia forces for the two cylinders will be out of phase with each other. Since all of these forces are vector quantities, it is important to keep them in the proper angular relationship. In order to illustrate this point the main bearings of an eight-cylinder in line engine will be examined. It is assumed that the usual nine bearing crankshaft is being used as indicated above in figure 5.

On all engines having an even number of cylinders the highest average load falls on the center main bearing if all the rotating weights are not completely and exactly counterweighted. Few engines are counterweighted more than 90 per cent and many engines have no counterweights at all. The net unbalanced centrifugal force of half a throw can be added algebraically to one-half the centrifugal force of the heavy end of the connecting rod. In calculating the load on any main bearing these resultant centrifugal forces for two adjacent half-throws are added vectorially. From an inspection of the diagrams in figure 6 it can be seen why the highest average load falls on the center main bearing.

The construction of the polar diagrams for the main bearings is similar to the method used for the crankpin bearing diagram. Since the crank throws on each side of the center main bearing are in the same plane, the resultant forces in this bearing repeat themselves with each revolution (see figure 7). On the other hand, it requires two revolutions to complete a polar diagram for an intermediate bearing as shown in figure 8.

From an inspection of figure 5 it will be seen that the loads on the main bearings of an eight-cylinder in line engine are alternately high and low as noted. This is a result of the assumption that the crankshaft has no stiffness, which, of course, is not true. In an actual engine we would expect the bearings with the low average pressures to relieve some of the load from the highly loaded bearings. In other words, the loads would tend to become more evenly distributed as in a six-cylinder four-cycle engine where the loads on the intermeriate main bearings are all alike. In a six-cylinder engine with the throws at 120 degrees the loads on the intermediate main bearing will be less than on the bearings between cranks at 90 degrees (eight-cylinder engines), but more than on bearings between throws at 180 degrees (four- or eight-cylinder engines). The position of the crank throws assumes importance only at higher speeds where the rotating forces become appreciably large.

With increases in engine speeds the average pressure on the bearings also becomes larger. The maximum pressure will decrease to a certain minimum and then grow larger with increasing speed as shown in figure 10. The PV factor naturally becomes larger with a rising rpm. Although it is known that the shape of the indicator card changes with varying rpm., it is customary to assume a constant full load indicator card over the entire speed range. The reciprocating and rotating inertia forces vary

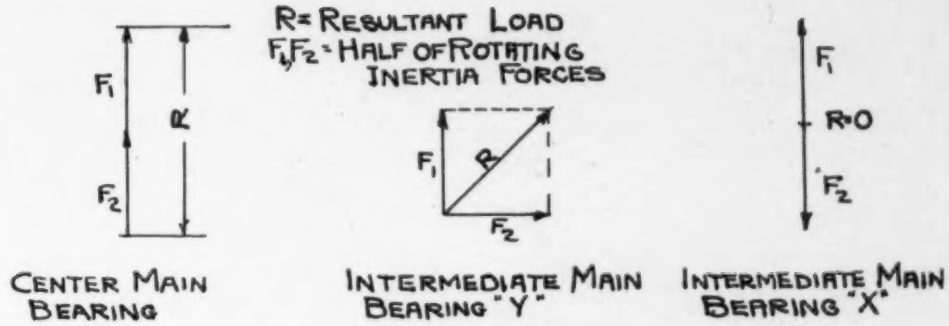


Fig. 6 - Rotating Inertia Forces On Main Bearings

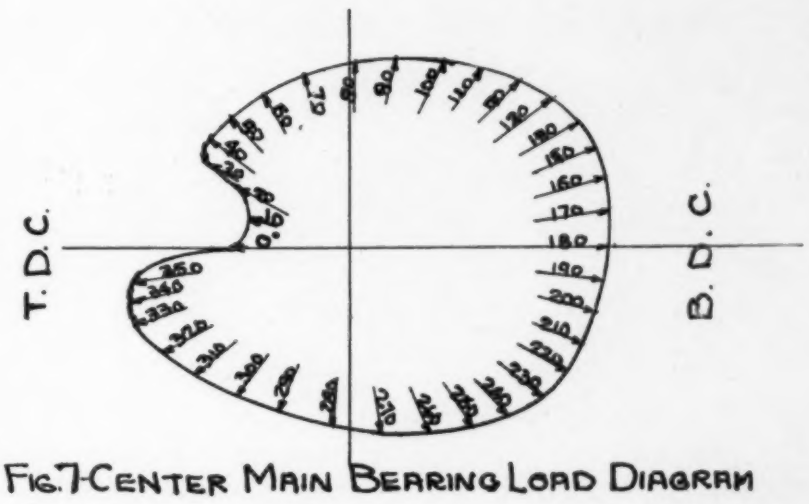


Fig. 7-Center Main Bearing Load Diagram

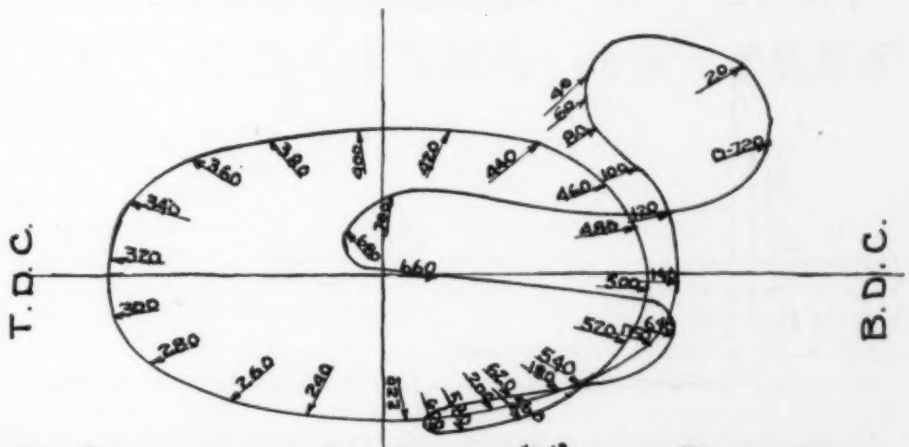


Fig 8 Intermediate Main Bearing "Y" Load Diagram

as the square of the engine speed (see equations 3 and 4). Considering these facts we can expect the shape of the polar diagrams for all bearings to change with varying engine speeds. The superimposed diagrams for a center main bearing shown in figure 9 indicate the effect of engine speed on the average loads on a bearing. The maximum allowable limits for the average pressure, maximum pressure and PV value is dependent upon the bearing material. By calculating these three measures of bearing life for various engines where the bearings have

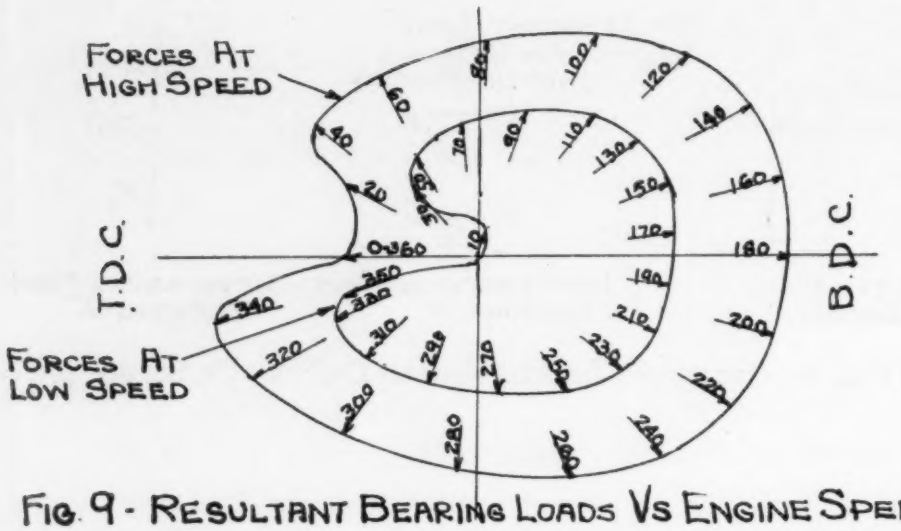


FIG. 9 - RESULTANT BEARING LOADS VS ENGINE SPEED

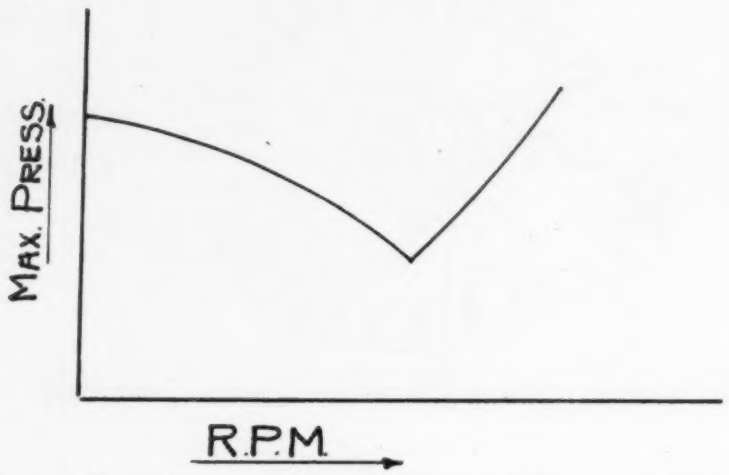


FIG 10. MAX. PRESSURE VS ENGINE SPEED

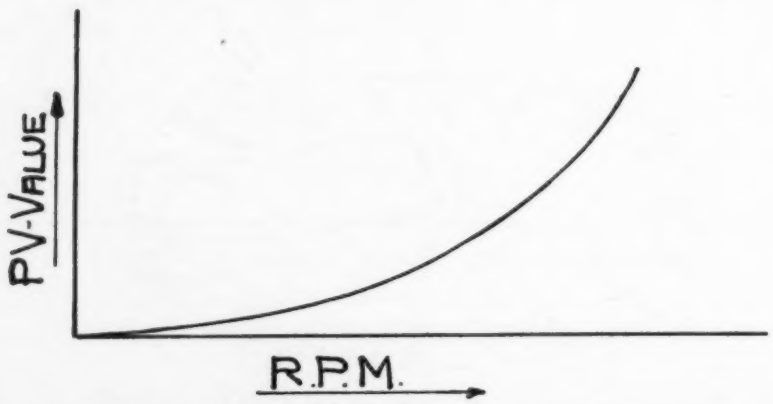


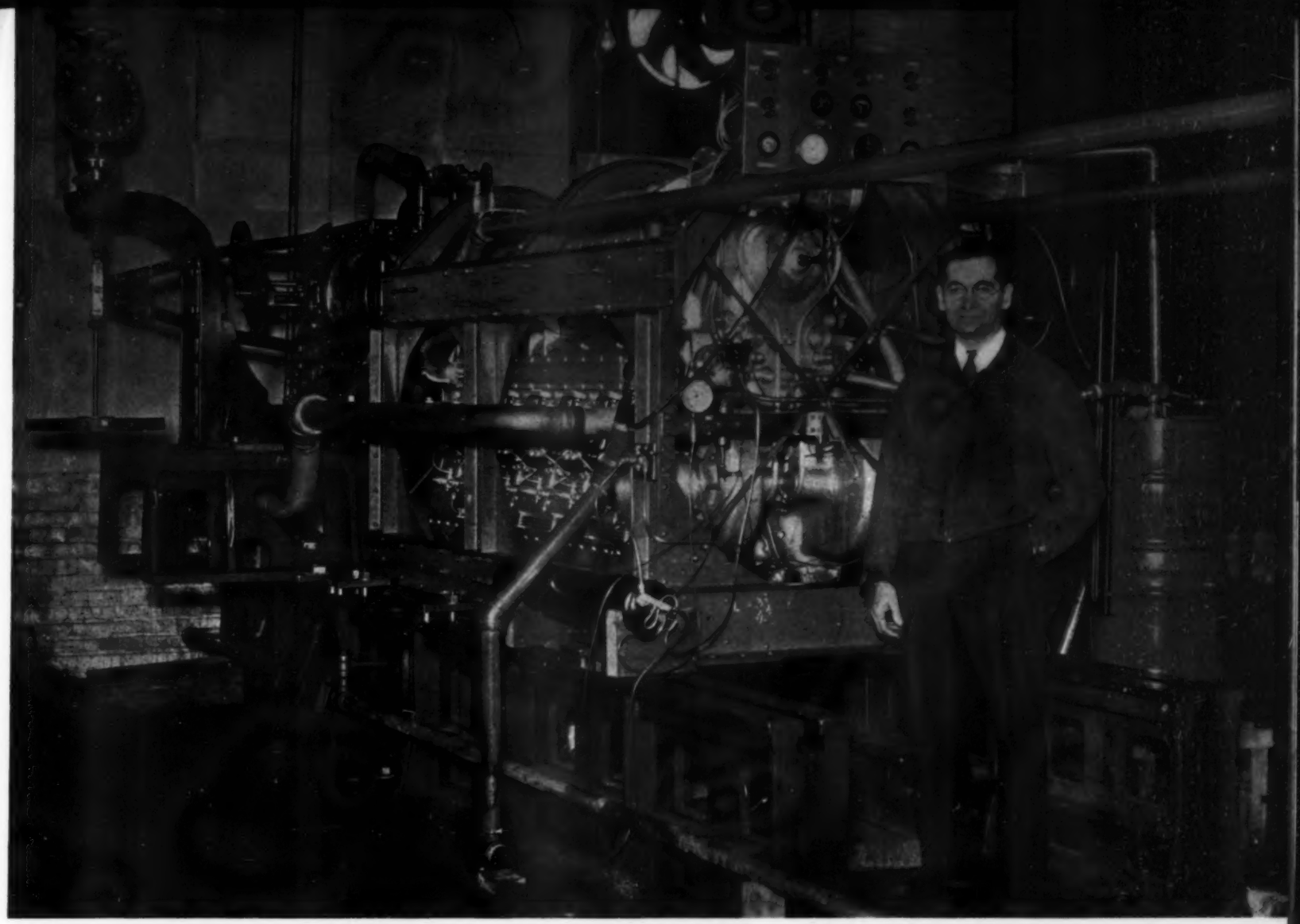
FIG. 11- PV-VALUE-VS. ENGINE SPEED

either failed or stood up, the top permissible values can be established. For example, the limits for an ordinary tin base babbitt are 1,500 pounds per square inch for maximum pressure, 500 pounds per square inch for average pressure and about 15,000 in PV value. For high lead babbitts, the same limits are 2,000 pounds per square inch maximum pressure, 650 pounds per square inch average pressure and about 20,000 for PV value. When some other harder bearing materials are used, the above limits can be raised. It should be understood that the hardness of the crank journals should correspond to the bearing material used and the average pressures applied in order to avoid excessive wear of the crankshaft journals. Against the bearing materials just named a crankshaft of SAE 1035 steel having a Brinnell hardness of about 200 will be found satisfactory.

Since in these calculations the accuracy of the results obtained will depend entirely on the data used, it is important that the indicator card should be typical of the application for which the engine is to be designed. A few examples will serve to illustrate this point. In constant speed generator drives only one indicator card for full load and maximum pressure must be studied. For automotive or direct drive rail car engines, the highest explosion pressure will occur at low speeds under full load unless a variable timing device is used. As shown previously the bearings will be subject to highest average pressures at full speed. Therefore, for engines of this class, indicator cards for both ends of the speed range should be examined. In marine engines the load (BMEP) increases with speed. Hence in these engines the top speed condition would impose the highest loads on the bearings. From these illustrations it can be seen that if the proper data is applied this method of bearing load analysis is not limited to any particular type of service.

In establishing the top permissible limits of maximum and average pressure and the PV value it should be remembered that there are certain variables beyond the direct control of the designer which affect the durability of bearings. Although such factors as fuel quality, oil viscosity, running clearance and degree of finish all affect bearing life, they must be considered as fixed quantities for calculation purposes.

The advantages of attacking bearing problems logically are many. First of all, a basis of comparison is established. The severity of loading at each bearing is shown with respect to each other and sources of trouble are indicated. Also, with the maximum and average pressure and PV factor data, it is possible to compare different engines. Second, these data furnish engineers with a basis for standardizing and rating various bearing materials. A standards system comparable to the SAE numbers for steels could be established. This obviously will prove advantageous to both the engine builder and the bearing manufacturer. And finally, the results of analyzing bearing problems logically will permit engine builders to utilize the full load carrying capacity of the bearings with safety. The factor of safety will be known; the factor for ignorance will be eliminated.



The 1,200 hp. 12-cylinder Deschamps Diesel on the test stand. With the engine is its designer, Mr. D. J. Deschamps.

DIESEL AIRCRAFT ENGINES ON TEST

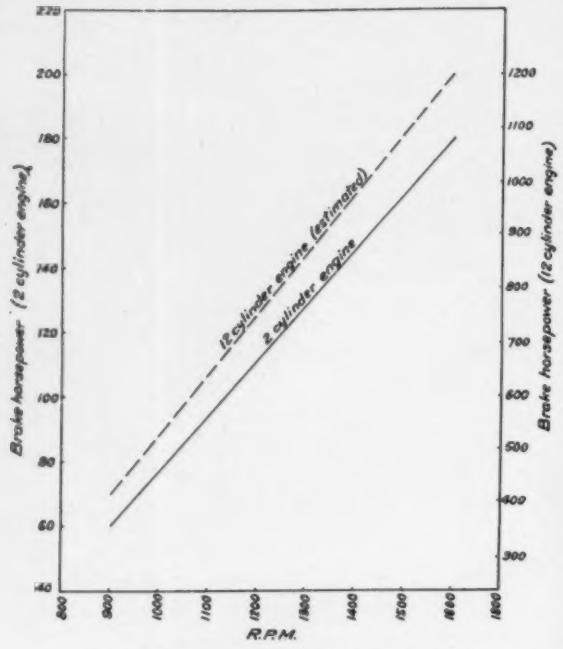
By PAUL H. WILKINSON

THE testing of an aircraft Diesel does not involve any particular problem other than perhaps, the starting of an engine of considerably higher compression ratio than is found in the gasoline engine. Starting an engine with a compression ratio as high as 18 to 1, naturally requires more powerful equipment than to turn over one with 6.5 to 1 compression. An item to be considered with relation to the starting, is the fuel injection system. If the injection pressure is too low or the holes in the nozzles are too big, the fuel will not atomize and mix with the air sufficiently to start combustion.

The liquid-cooled, double-bank Deschamps Diesel shown on the test stand, is started by compressed air at 850 lb. per sq. in. pressure. This air, when admitted to the left bank of cylinders through a distributor on the end of the valve camshaft, turns the engine over at 120 rpm. and combustion starts in the right bank. After the air is shut off, combustion then starts in the left bank in the usual way. Decompression until the engine is turning over at this speed, is accomplished by sliding the camshaft axially to hold the valves open. A Bendix-Heywood two-stage air compressor is mounted on the engine.

The engine is shown coupled to a Froude hydraulic dynamometer, type DPX-6, of 1,500 hp. capacity, manufactured by the C. H. Wheeler Manufacturing Co. of Philadelphia. Short test runs of 5 to 6 hours' duration have been completed with this equipment, during which the engine was run up to 1,300 rpm. and developed 850 hp. On the instrument panel above the engine, are the oil pressure and fuel pressure gauges, and the gauges for the cooling water which was used instead of Prestone for these tests. One of the tachometers is connected to the camshaft running at half engine speed, while the other is connected to one of the superchargers to check any slip which might occur in the clutches of the overrun drive to the latter.

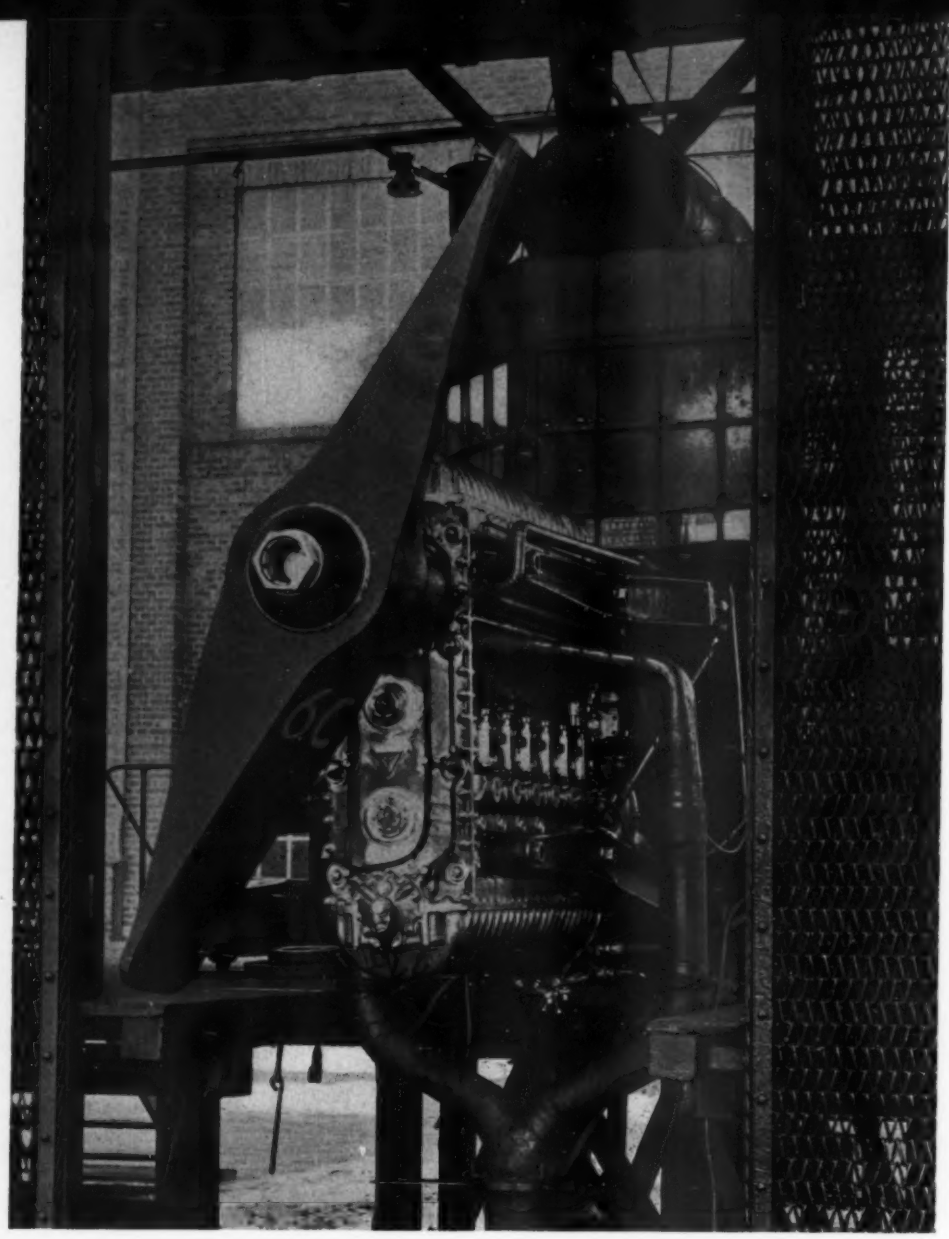
Previously, a two-cylinder experimental Deschamps engine had been run at various speeds, as is shown on the power curve, and from this it was possible to predict the performance of the full-size, twelve-cylinder engine. In the latter case, the power output is slightly higher in proportion inasmuch as relatively less power



Power curve of experimental 2-cylinder Deschamps engine, and estimated power curve for 1,200 hp. 12-cylinder engine.

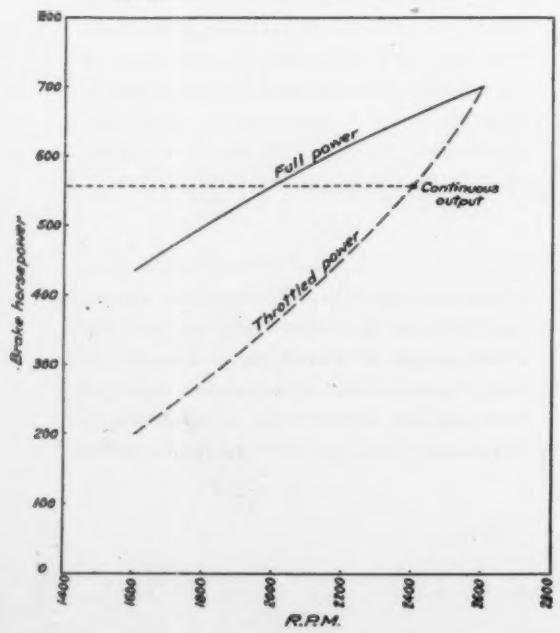
is absorbed to drive the engine accessories. Fuel consumption well below 0.40 lb. per hp. hr. should be possible, as this has already been obtained with other aircraft Diesels under average flight conditions. When in production, it is estimated that the weight of this model of the Deschamps Diesel could be brought down to at least 1.75 lb. per hp.

For type-testing Junkers aircraft Diesels, a hydraulic dynamometer or water brake of their own manufacture is used. These highly efficient machines are made in various sizes up to 7,000 hp. and are used extensively in Germany and other countries for a variety of purposes. Engines off the production line, are tested with propeller "clubs" on outdoor stands under the supervision of engineers in well-protected booths. The exhaust is led away in a large pipe and is adequately muffled before being released into the atmosphere. The power curve shows what the Junkers *Jumo 205-D* (1937) Diesel will do. For take-off, its full rated power of 700 hp. is available, while 630 hp. can be taken from the engine for a period of 30 minutes. For continuous cruising, 560 to 590 hp. is available, this being 80 per cent of the rated power of the engine. Fuel consumption at full power is 0.37 to 0.40 lb. per hp. hr.; while at cruising speed, it is 0.35 to 0.37 lb. per hp. hr. These figures make an interesting comparison with the *Jumo 5* (1935), which was rated at 560 hp. at 2,100 rpm. and cruised at 420 hp.; and the *Jumo 205-C* (1936) rated at 600 hp. at 2,200 rpm., with 520 hp. available for continuous cruising. It is evident that increased rpm. had a good deal to do with this increase in power.



How a Junkers "Jumo" 205 Diesel is run on the test stand before shipment from the factory.

Maximum power and throttled power curves of 700 hp. Junkers "Jumo" 205-D Diesel.



The latest news from France is to the effect that the Coatalen 12 Vrs 2 Diesel is undergoing its homologation tests at the Service Technique de l'Aeronautique Francaise (S.T.A.T.) in Paris. It is understood that a fuel consumption of 0.34 lb. per hp. hr. has now been obtained, and that the engine will soon be ready to be test-flown. This fuel consumption is excellent in every way and undoubtedly can be still further reduced. Already, fuel consumption as low as 0.29 lb. per hp. hr. has been reported in the United States, while a number of runs at 0.32 and 0.33 lb. per hp. hr. have been made. Thus we see that fuel consumption of the gasoline engine is not fast approaching that of the Diesel, as so many people would have us believe—on the contrary, as gasoline consumption is lowered, so is Diesel fuel consumption likewise being reduced.

Fuel consumption is always an important factor when long-range flights, such as the transatlantic crossing, are involved. At the present

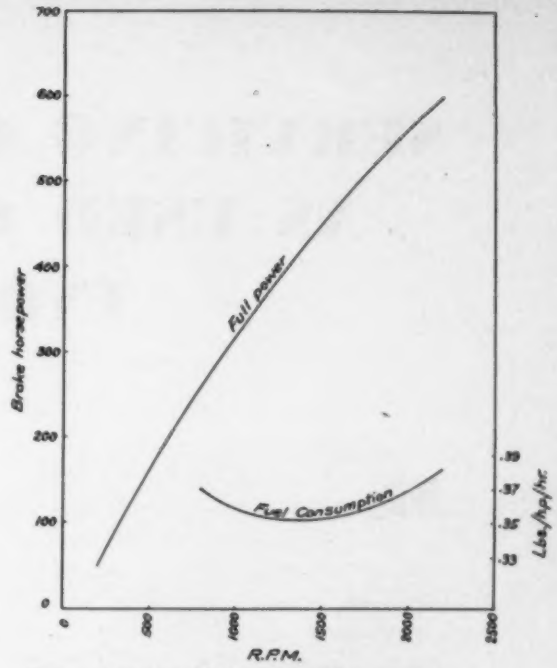
moment, the fuel problem is causing Imperial Airways grave concern. One of their difficulties seems to be to carry a worthwhile payload — even 1,000 lb. of mail — at a reasonable operating cost across the ocean. Hundreds of thousands of dollars have been spent on the "Mayo composite planes" (see DIESEL PROGRESS of December, 1937) in a frantic endeavor to find means of carrying the mail from Southampton to New York. The upper and lower composite planes have been built and tested, and it has been shown that it is possible to separate them in the air. But it has not been shown, however, that the upper or mail-carrying plane can be successfully launched in this manner *under average weather conditions* at its full flying weight of over 20,000 lb. for the crossing.

In another attempt to solve the problem, Imperial Airways has ordered that eight of their 45,000 lb. "Empire" flying boats now under construction, should be strengthened to permit the carrying of 5,000 lb. additional payload over and above the 1,000 lb. mail load for which they were designed. Structural changes would add 3,000 lb., so that the gross weight of the plane would be increased to 53,000 lb. Cruising with 18 per cent additional weight in this manner, will involve taking more power from the engines which again will increase their fuel consumption. If the engine power output is kept the same as before, the flying speed will be reduced and the time required for the crossing will be increased, which amounts to the same thing.

It is not an easy matter to get a flying boat in an overloaded condition such as this off the water, even under the best conditions. If passengers are on board, the risk is greater still. Imperial Airways, aware of this risk, now proposes to have the transatlantic flying boat take off with a light load of gasoline and then be refuelled for its long journey from a "tanker" plane in the air. While it is true that planes have been refuelled in this manner before, only comparatively small quantities of fuel have been transferred and then only under "stunt" conditions and at pilots' risk. To attempt to transfer large amounts of fuel in this manner as a routine procedure, whether there are passengers on board or not, certainly shows poor judgment.

Can it be that Imperial Airways deliberately chooses to ignore the terrible risk of drenching the transatlantic plane with gasoline through misjudged or interrupted fuel connection in bumpy weather, when a spark of static electricity would be all that was needed to set the planes on fire? Can it be that Imperial Airways has so soon forgotten the terrible disasters which have occurred to flying boats within the last few months while dumping (or transferring) their gasoline while in the air? Does not Imperial Airways remember what happened to the Pan American-Grace airliner off Panama last August, when 14 people lost their lives; to the Pan American "Samoan Clipper" in the South Seas last January when Capt. Musick and his 6 companions were burned to death; and to the Italian plane in the South Atlantic last February when 4 out of the 5 occupants perished in like manner? Can it be that Imperial Airways will risk a repetition of these disasters when they can be avoided?

These, indeed, are weighty questions to be considered before embarking on an enterprise in which the risk is out of all proportion to the gain. If Imperial Airways had ordered sturdy four-engined seaplanes with ample room for



Power output and fuel consumption curves of 600 hp. Coatalen 12 Vrs 2 Diesel.

adequate crews, and had arranged to launch them from land catapults across the ocean, then they would have accomplished something. If they had then obtained Diesel engines for these planes, their problem of carrying 1,000 lb. of mail, or even two or three times this amount, would have been solved.

The same line of reasoning applies to their flying boat situation. If they had insisted on the Air Ministry developing 1,000 hp. Diesels for their transatlantic planes before they made even so much as one trial flight across the ocean, there would have been such a popular outcry that the engines would have been produced. There can be no question now as to what engine is best suited to their needs. Great Britain should have these much-needed Diesels without delay, not only for the Empire routes of Imperial Airways, but for their Royal Air Force and their National Defense.

The 600 hp. Coatalen 12 Vrs 2 Diesel which is now undergoing its homologation tests in France.

SERVICING OIL-WASHED-AIR CLEANER AS USED ON MANY TRACTOR AND INDUSTRIAL ENGINES

By FRED R. NOHAVEC*

MANY articles have been written on taking care of tractors and tractor equipment after the fall work is done and before the tractor is put up for the winter. The modern tractor is used so much for year-around work that the tractor should be watched constantly and repairs made as required.

Tractor Investment

The investment in a tractor makes it important enough so that it should always be kept in first-class operating condition. To do this, every part subject to wear or deterioration should be watched carefully and checked constantly. However, one of the most important factors, in getting the most from your investment, is to take care of the air cleaner which was put on the engine to insure a supply of air free from dust.

Purpose of Air Cleaner

The air cleaner is put on the tractor, or power unit engine, to prolong its life and performance by preventing dirt and grit from entering the engine along with the air required for combustion, thus reducing excessive wear on moving parts.

When to Service Cleaner

The cleaner can do its work best only when it is serviced properly. It should be serviced often enough so that no dust can get through to the engine. It is difficult to state just how often an oil-washed cleaner must be serviced for this depends largely on the dust conditions. However, the operator must keep in mind that the service a motor will give depends on how well the cleaner is cared for and, therefore, he is charged with the responsibility of giving the air cleaning equipment regular and constant attention. Always bear in mind that the dustier the air condition, the more often attention will need to be given to the cleaner.

Servicing the cleaner should not be left to memory or guesswork, but should be checked by inspecting the cleaner cup at regular intervals during the operating time. After a few inspections the operator can easily tell how rapidly the dust collects. As dust collects in the cup of an oil-washed cleaner the oil begins to thicken. Before the oil becomes too thick to flow freely it should be replaced. Under unusually severe dust conditions this may be necessary two or three times a day, but under average farming conditions daily servicing is generally sufficient.

Oil-Washed-Air Cleaners in General Usage

Most tractors and industrial engines are now equipped with an oil-washed cleaner or an oil bath cleaner. The servicing and the grade of oil used apply equally well to both types.

Care of the Oil-Washed-Air Cleaner for Maximum Efficiency and Protection

The best performance of an oil-washed cleaner is obtained by keeping the oil level up to the bead at the center of the oil cup, which is called the oil level bead. Raising the oil level above this point does not increase the efficiency, and to use a higher level is a waste of oil, and in some cleaners may be very detrimental, if too high an oil level is carried.

To get the best results from an oil-washed cleaner the following points should be carefully followed:

(1) Inspect connections from cleaner to carburetor and manifold frequently to see that connections have not become loosened. When throttle and choker shaft have become worn they should be replaced or sealed. An unbelievable amount of dust can go through a very small opening and do a great deal of damage.

(2) Fill oil cup with an oil that will flow freely under the prevailing temperature. In summer an oil of SAE 30 or 40 rating may be used, or it may be satisfactory to use the same grade of oil as used in the engine crankcase. In cold weather it is best to use a 20 oil in temperatures above freezing, and an SAE 10 oil at temperatures of zero to 30° above. At temperatures below zero it is best to use SAE 10 or lower, unless the temperature is 30° below, when it may be necessary to dilute SAE 10 oil with Diesel fuel oil. Do not use gasoline to dilute the oil, as gasoline evaporates. *Always* use an oil that flows freely and easily under existing temperatures.

(3) Service cleaner as often as it needs it. The best time to do this is at noon and again at night just after the engine is stopped, but before the engine has stood for any length of time. If the cleaner is left to stand for some time, the fine dust settles out of the oil, leaving a layer of clean oil at the top. This may lead the operator to believe that all of the oil is clean, whereas there may be a heavy layer of dirt in the bottom of the oil cup, and the next day's run may collect enough dust to overload the cleaner.

The screens in an oil-washed-air cleaner will require very little attention if the above instructions are followed. However, the filter element, or the screen condensing element, should be inspected whenever the cup is removed, because lint, chaff and other light materials do not settle in oil rapidly, and occasionally a small deposit may accumulate. This can easily be washed by dipping the lower part of the cleaner in a bucket of gasoline.

The air cleaner used on tractor and industrial engines may be referred to as the life of a motor; for this reason we are repeating the service bulletin which is included in many tractor service manuals.

Operation and Care of the Oil-Washed-Air Cleaner

The air cleaner is put on the tractor engine to prolong its life and performance by preventing dirt and grit from getting into the engine, causing excessive wear on all operating parts. *However, the tractor operator is of necessity . . . .* *And now please turn to page 60*

*Donaldson Company, Inc., St. Paul, Minn.

"Dolomite II," powered with two Alco locomotive type direct reversible 8 cylinder, 720 hp., 600 rpm. engines.

"DOLOMITE II"

By JOHN W. ANDERSON

BUILT for coastwise, canal and lake service, this oil tanker has twin screw Diesel engines for propulsion. The machinery is located in the stern of the ship and there are several interesting items that add to the completeness and simplicity of the arrangement.

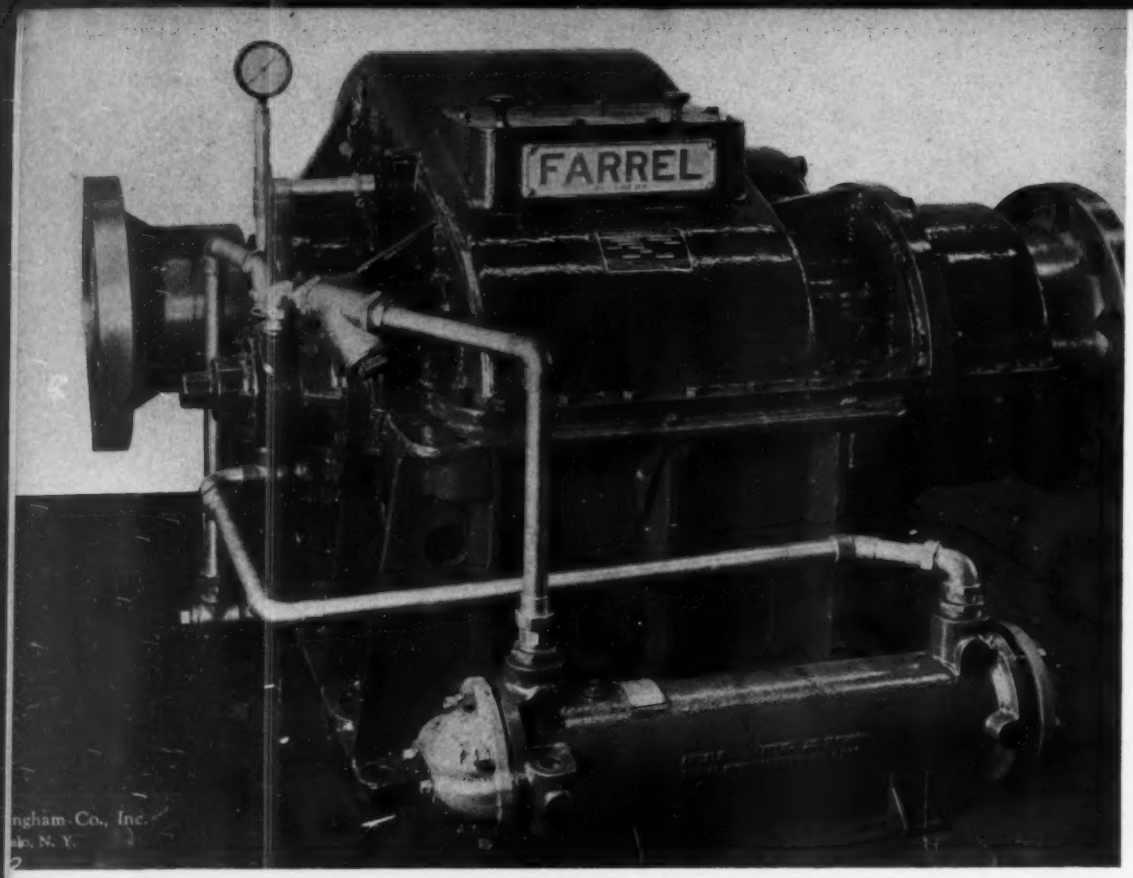
Across the front of the engine room is the switchboard which not only carries the electrical instruments, but also the dials giving the engine telegraph signals from the pilot house and the pyrometer for the main engines. On the starboard side outboard of the main engine are the auxiliary generating units and the work bench is in the forward corner. On the port side are the heat exchangers, the condenser, and the pumps. The lubricating oil purifier is in the forward corner. Way aft in between the tail shafts is the steam boiler.

On the deck above the engine room are the galley and many of the living quarters. These are roomy and comfortable. There are windows around the engine room trunk where it passes through the living quarters.

The most interesting items are, of course, the main propelling units. Built right and left hand, these two Alco Diesels stand alongside of each other in the middle of the engine room.

The main engines are fully enclosed and direct reversible. Each engine has eight cylinders, 12½" bore by 13" stroke, of the four cycle, solid injection type, and is rated at 720 hp. at 600 rpm. Already described in detail in Vol. 2 of the DIESEL ENGINE CATALOG, beginning on page 137, it is unnecessary to discuss them here except to describe the reversing mechanism.

These engines are reversed by sliding the camshaft longitudinally. The entire control of the engine is centered in the single large handwheel located at the side of the engine near the middle of its length. If the top of the handwheel is turned toward the bow of the vessel, the engine runs ahead; if toward the stern, the engine runs astern. The mid-motion of the handwheel places the camshaft in the proper position and vents the engine cylinders. When the handwheel is moved to its extreme position, maximum fuel and starting air are turned on, and the engine starts. As soon as the engine starts to turn, the handwheel is turned back to give the desired speed. To stop the engine, the handwheel is moved nearly to mid-position. The whole action is simple and rapid.



Farrel Birmingham reduction gears rated at 1,000 hp., reducing from 600 to 304 rpm.

This is made possible by the pneumatic operating arrangements used. The cylinders are vented by pneumatically lifting the safety-relief valves. The air starting valves are also operated pneumatically from distributors situated on the end of the fuel injection pump shaft.

In order that the engineer may know the speed of his engine, there is a tachometer dial located at the control station. A small red hand on the tachometer dial turns continuously with the engine, so that the operator may know when the engine is running and in which direction. It gives him a positive check on the proper response of the engine to the control gear.

The main engines drive the propellers through Farrel-Birmingham reduction gears. The reduction in speed is from 600 rpm. engine speed to 304 rpm. propeller speed. These gears are rated at 1,000 hp. to give an ample margin for contingencies in service. Several of these engines have been installed for continuous service at a rating of 150 hp. per cylinder, using Buchi superchargers, and later these engines may be supercharged. In operation these gears run very smoothly.

An interesting little item is the method of marking the engine telegraph dials. They are marked for 50, 100, 200 and 300 rpm. of the propellers, ahead and astern. The operator can easily see these from his position between the engines. Adjacent to the signal dials is the Taylor pyrometer with the two eight-point switches, one for each main engine.

Intake air for the main engines is taken directly from the engine room through the headers on the engines. Exhaust is from the after end of the engine headers into the Titusville boiler located at the after end of the engine room. This boiler is of the Scotch single furnace type with Dutch oven and is fitted with independent oil firing for maintaining the steam pressure when the vessel is in port and the propelling engines are not running.

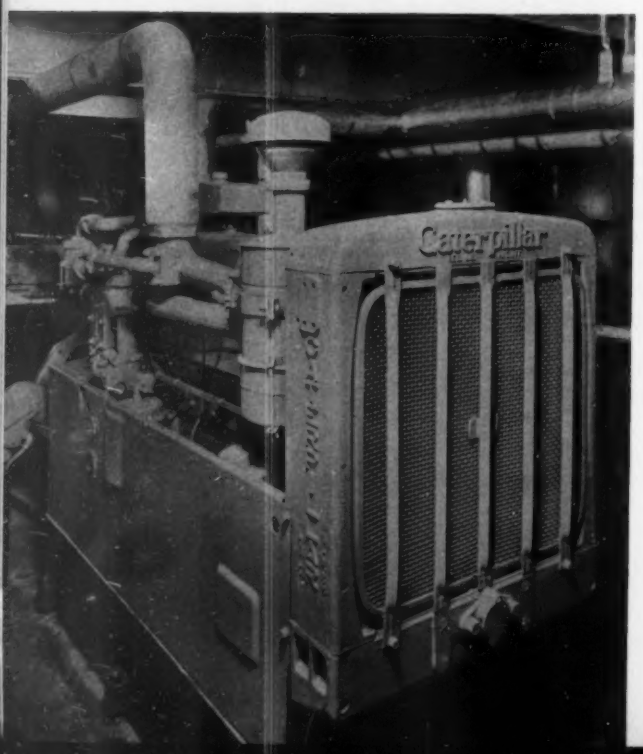
This boiler supplies steam for heating the living quarters, for the steering gear, the deck winches, a steam whistle, and for the Moore steam turbine on one of the auxiliary generating sets. In addition to the steam whistle, there is an air horn.

Fuel oil is supplied to the main engines from the bunker tanks in the forward corners of the engine room by motor driven transfer pumps through Protectomotor filters.

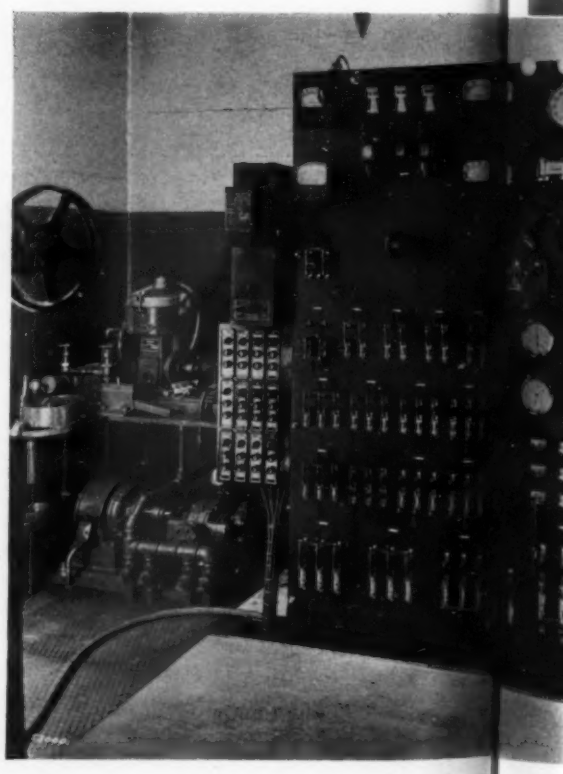
Each engine has its own lubricating system with attached pump for circulating the oil and maintaining the pressure. All parts of the engine needing lubrication are taken care of by this one system. Mounted on the engine is a twin Schutte Koerting filter. In addition, there is the Hydroil centrifugal already mentioned as located in the forward port corner of the engine room.

Cooling water is circulated on the closed system through the engine jackets and the heat exchanger by motor driven Worthington centrifugal pumps. Thermometers are fitted on the inlet and outlet connections and a valve on the inlet near the operator's station permits of controlling flow through the jackets during maneuvering.

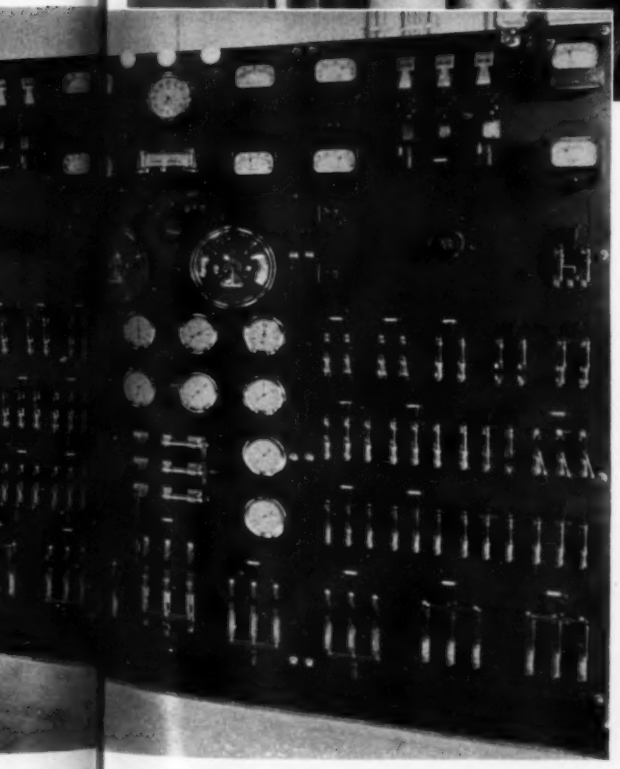
Two motor driven starting compressors are fitted and ample storage capacity is provided to take care of maneuvering of the main engines.



30 hp., four-cylinder, four-cycle Caterpillar auxiliary generating unit.



Built right and left hand, these two Alco four-cycle, solid injection 720 hp. Diesels stand alongside of each other in the middle of the engineroom.

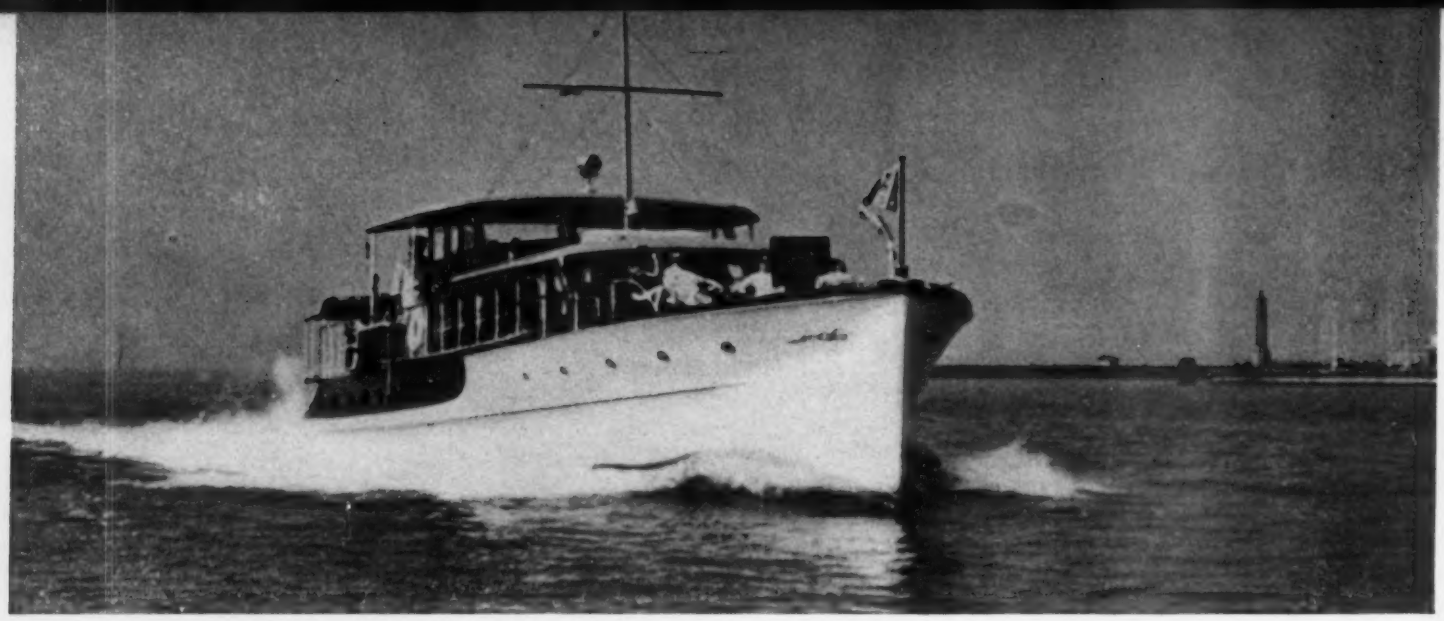


The switchboard carries the electrical instruments, the Taylor pyrometer for the main engines, and the dials giving the engine telegraph signals from the pilot house. To the extreme left is the Goulds Hydroil lubricating oil centrifugal purifier.

The turbine of the steam driven auxiliary generating set already mentioned operates condensing, and the condenser equipment with the necessary pumps is located on the port side of the engine room.

The second auxiliary generating set consists of a four cylinder, four cycle Caterpillar Diesel rated at 30 hp. at 1,200 rpm. and direct connected to a Westinghouse alternator and exciter. This engine is a standard unit such as is described in the DIESEL ENGINE CATALOG, Vol. 2, beginning on page 25. The alternator generates 60 cycle current at 230 volts. On the switchboard is a Ward Leonard voltage regulator. Lighting circuits on the vessel are standard 110 volts, but the 220 volt circuits are used for power.

This layout of machinery gives good accessibility to all of the units and convenience of operation. And the important item of economy of operation has not been overlooked either. The steam boiler with steam and Diesel driven auxiliary sets permits of adjustment of machinery in operation to suit the conditions at the moment and take full advantage of all possible economies of operation.



NANCY ANN III

By GEORGE D. CROSSLEY

THE *Nancy Ann III* was designed and built by Henry C. Grebe & Co., Inc., Naval Architects, and is owned by Albert Stein of Chicago, Ill.

Principal dimensions are 62 ft. 10 in. overall, 61 ft. 6 in. waterline, 14 ft. 8 in. beam, 3 ft. 9 in. draft.

Fitted with a pair of eight cylinder, 150 hp. Superior Diesel engines, this trim yet spacious vessel has a speed of 16 miles per hour. The boat and engines are equipped with Bendix Vacuum Controls on the bridge, and both the throttles and reverse gears are operated by these controls. Exide 32 volt heavy-duty starting batteries are used for lighting the vessel in addition to engine starting.

Three double staterooms aft, two tiled lavatories, comfortable deckhouse, galley and crew's quarters forward, together with her dependable and successful Diesel operation, all bespeak of Mr. Stein's complete satisfaction with the *Nancy Ann III* after considerable cruising experience. Of noteworthy importance is the fact that she is insulated for both sound and heat.

Engine room of "Nancy Ann III" showing ample space available around two Superior Diesel engines.

● For approximately eighteen months the Enterprise Diesel units at Palomar Mountain have provided all power used for the construction of this huge observatory. Concerning the Woodward Governors on these engines Mr. Emmett M. Irwin, of the Astrophysical Observatory, in the article appearing in this issue of Diesel Progress, writes:

"The possibility that the power system may be subjected to highly fluctuating loads due to the rotation of the dome, hoisting with the crane, etc., made good speed regulation on the generating units essential. Accordingly they were provided with Woodward type IC governors. These governors are equipped with synchronizing motors to permit synchronizing the generators from the switchboard. They also have speed droop and load limit controls. With these governors and extra heavy flywheels the units are capable of furnishing very constant frequency current even with fluctuating loads."

WOODWARD GOVERNORS for DIESELS

WOODWARD GOVERNOR CO.

WORLD'S OLDEST AND LARGEST EXCLUSIVE MANUFACTURER OF HYDRAULIC GOVERNORS FOR PRIME MOVERS

ROCKFORD, ILLINOIS

PALOMAR MOUNTAIN

. . . . *Continued from page 27* . . . .

Engine No. 1

Fuel Oil Used	1970 Gallons
Lubricating Oil Used	23 "
Kwh. Generated	19820
Hours of Operation	538
Average Load	36.8 Kw.
Aver. Fuel Consumption	.0997 Gal/kwh.

Engine No. 2

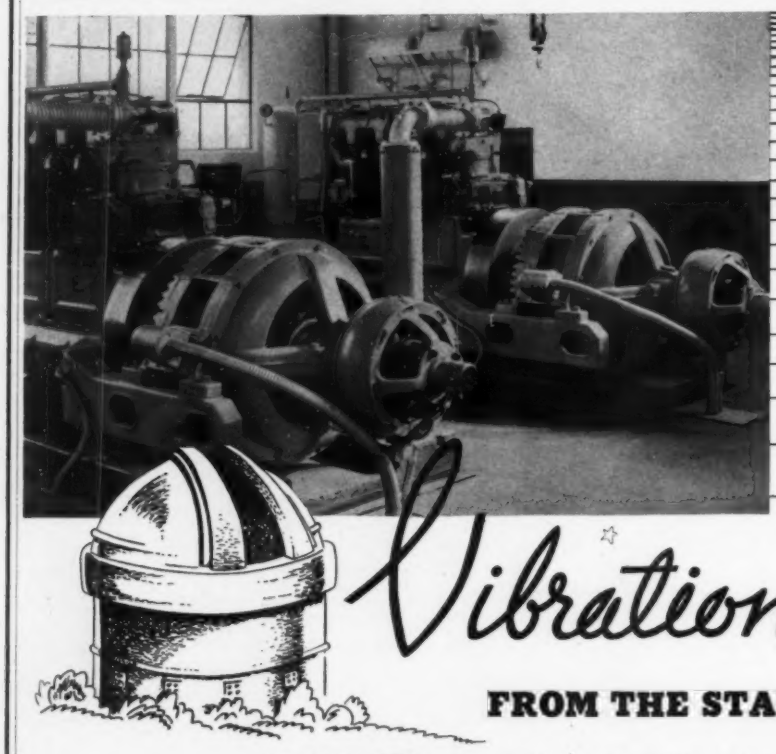
Fuel Oil Used	1456 Gallons
Lubricating Oil Used	18 "
Kwh. Generated	15560
Hours of Operation	409.9
Average Load	37.96 Kw.
Aver. Fuel Consumption	.0935 Gal/kwh.

During the eighteen months that the plant has been in operation very accurate data has been kept of operating costs. Readings of instruments are taken twice a day and a log kept. One operator only is on duty and then for eight hours. When on duty his time is divided between the generating equipment and machine work in the shop. On an average it is estimated that not over one-third of his time is spent on the generating equipment. When the operator is off duty, the generating equipment operates without attention. This, of course, is made possible only because of the protective equipment and the Leeds & Northrup equipment which controls the speed and load conditions on the engines. An alarm operated from batteries is arranged to sound in case of failure of power and in this case it is the duty of the operator to see that power is available again. So far the operator has had his sleep interrupted only twice and then the shutdowns were only from minor causes and power was available again in a few minutes.

The experience gained from a year and a half of operation has convinced the Institute of the economies to be gained from the generation of their own power at Palomar. Careful checks have recently been made of the relative costs of generated and purchased power and it has been decided to continue the generation of power. This will require the installation of additional generating equipment since the existing units will be unable to handle the load when the 200-inch telescope is put into operation. Estimates of the plant load when the observatory is finally put into operation show that the plant capacity should be increased by an additional generating set rated at 150 kw. with a 25 per cent overload capacity for one-half hour. This will give considerable range in generating capacity which may be connected to the bus, as a range from 60 kw. to 270 kw. is available.

The excellent performance of the existing sets has justified the Institute in recently placing an order for another Enterprise generating set rated as above. This generating set will be powered by an Enterprise type DSW-6, six cylinder, 10-inch bore x 13-inch stroke engine similar to the existing engines. This engine will be direct connected to a 175 kw., 3 phase, 60 cycle, 480 volt Westinghouse generator and exciter. Auxiliary equipment for this generating set will be similar in all respects to the existing sets. The new generating set will be installed in the power house within a few months in time for additional heavy construction work on the telescope later this year.

When the 200-inch telescope is finally put into operation the power for moving and controlling this marvel of man's ingenuity will be furnished by Diesel power. It is no more than fitting that the latest laboratory product should be powered by the latest product of the commercial world, the Diesel engine.



Vibrations

FROM THE STARS . .

But **No Vibration** *from the Diesel Engines*

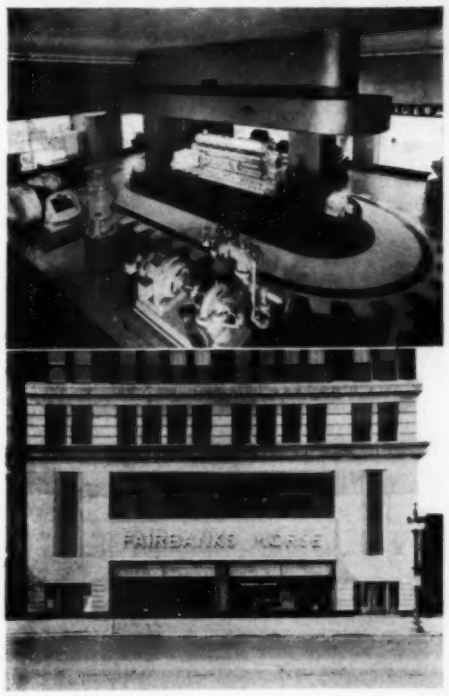
Korfund Vibro-Dampers are playing one of their most important roles in connection with the largest telescope in the world at the Mt. Palomar Observatory. Here is installed the famous 200 inch disc cast by the Corning Glass Works.

To make possible the operation of two 120 hp. Enterprise Diesel generating sets, it was vital that no vibration be transmitted to the adjacent telescope mechanism. The effectiveness of **Korfund Anti-Vibration Products** installed is proven by a repeat order for a 225 hp. Enterprise Diesel which will also be isolated by Korfund.

The KORFUND CO., Inc.
48-26 THIRTY-SECOND PLACE
LONG ISLAND CITY, NEW YORK
Use Quickmail Coupon No. 21

KORFUND
VIBRATION
CONTROL

FAIRBANKS-MORSE ANNOUNCES OPENING OF DISPLAY ROOM



FAIRBANKS, MORSE & CO. has announced the formal opening of its display room on the first floor of the modernized and renamed Fairbanks-Morse building at 600 S. Michigan Ave., Chicago. Dominating the exhibit here is a ten-ton, eight-cylinder Diesel engine for marine service. Grouped about this are electrical machinery, pumps, scales, railroad and farm equipment, household appliances, automatic coal burners and air conditioners – products that are manufactured in Fairbanks-Morse factories throughout the country and sold all over the world.

The exhibit room is geometrical rather than modern in architecture, and a power motif is carried out by a gear design in the floor. The color scheme of the entire display is aluminum with vermilion trim.

The company early in January moved its general offices to this new location from 900 S. Wabash Ave., headquarters of the firm for a third of its 108 years. Present offices are but eight blocks from the site of the first Fairbanks-Morse store in Chicago on State St. near Madison St. The firm was first known here as Fairbanks & Greenleaf Co. After the company's property was destroyed by the Chicago fire in 1871, Charles Hosmer Morse began business as Fairbanks, Morse & Co. As the company grew and required larger quarters, it moved first to the northwest corner of Lake and LaSalle Sts., later to Franklin and Monroe Sts., then to 900 S. Wabash Ave.

CONDENSER SERVICE & ENGINEERING CO. announce a recently developed Ribbon Counterflow Exchanger and Cooler with the following noteworthy advantages:

This exchanger or cooler has narrow, flat passageways for both liquids, arranged for true counterflow heat transfer.

There are no gasketed joints which could permit leakage between fluids, resulting in contamination.

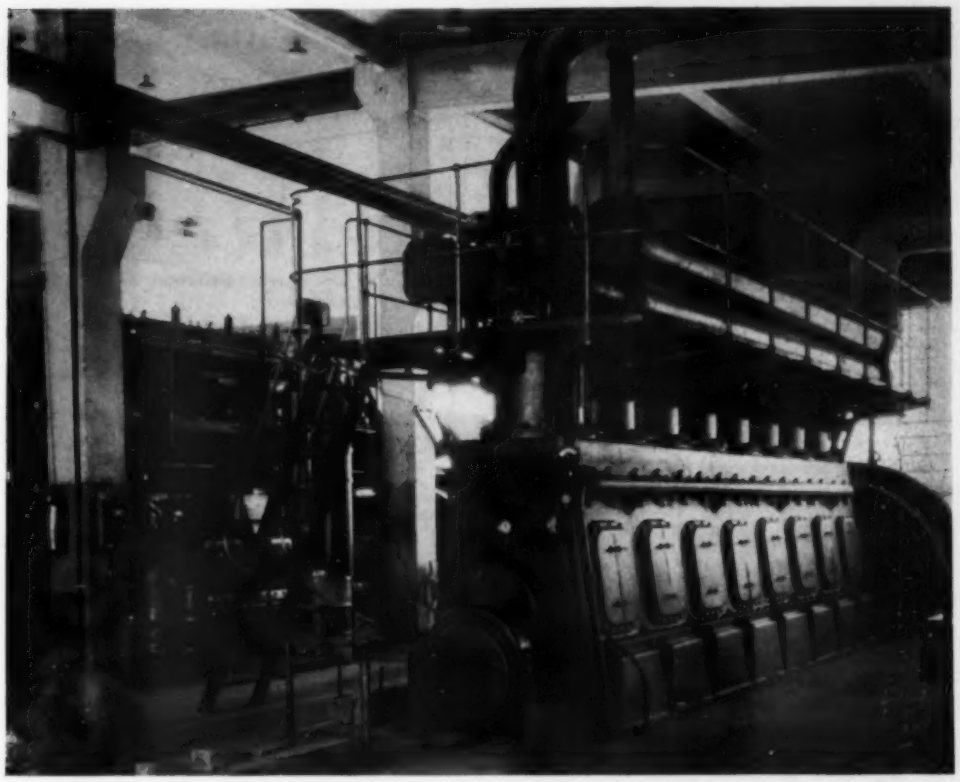
All passageways or transfer surfaces are accessible for cleaning. The passageways for one liquid can be opened for cleaning by removing two heads, without even shutting off the flow of liquid through the other passageway.

Passageways are streamlined to reduce turbulence and friction losses.

The passageways are very thin, causing intimate contact between all particles of the liquid and the heat transfer surface. This gives a very high heat transfer rate.

Performance tests, liquid to liquid, gave results considerably above the conventional tubular type exchanger. With clean surfaces, heat transfer rates of over 500 btu. per sq. ft. per degree Fahr. are obtained.

Full information may be obtained by writing to the Editor of DIESEL PROGRESS, 2 West 45th Street, New York, N. Y.



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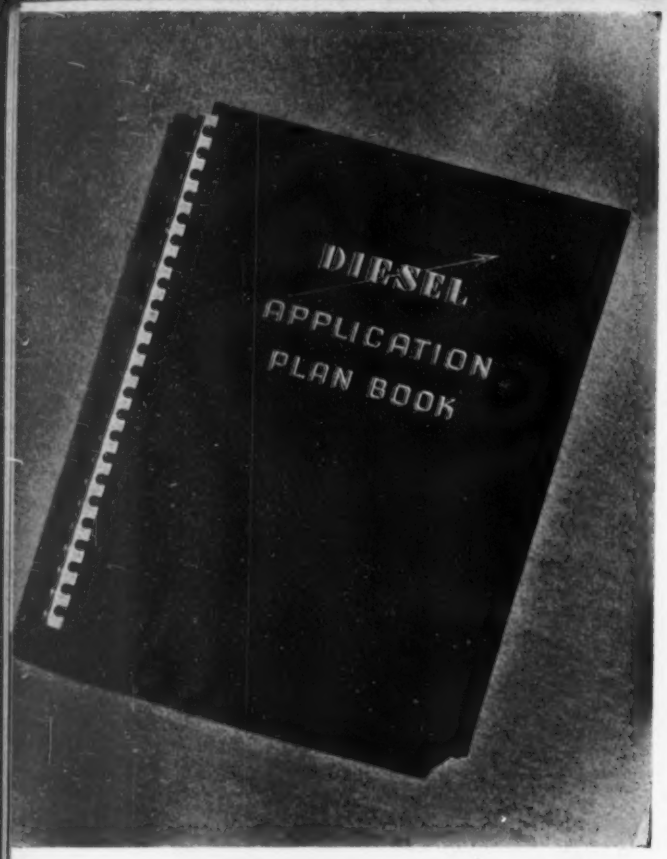

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S. A. E. NEWS

DIESELS continue to receive a substantial share of attention at National and Sectional meetings of the Society of Automotive Engineers. In Cleveland, on February 14, John Dickson of General Motors, speaking on his company's new Diesels, brought out that one Diesel locomotive will replace three conventional steam locomotives when used on long cross-country runs, because of its dependability and trouble-free service.

Huge flying boats carrying 100 passengers and powered by 1,500-hp. Diesel engines flying to Europe non-stop at 300 mph., were envisioned for the future by C. H. Schildhauer of Pan American Airways at the SAE National Aeronautic Meeting in Washington, D. C., March 10 and 11. "The compression-ignition engine with its minimized fire risk, cheaper fuel, elimination of radio interference, and low specific fuel consumption, may find its place in long-range flight operations," he stated.

At the Tulsa Section, W. S. Baker, the inventor of "Double-Seal" piston-rings, reported that the use of sealing rings in the upper grooves of the pistons of large slow-speed Diesels minimizes blowby and improves efficiency. However, he qualified, all efforts to apply sealing rings to high-speed automotive type Diesels have failed because of a consequent increase in oil pumping of about 20 per cent.

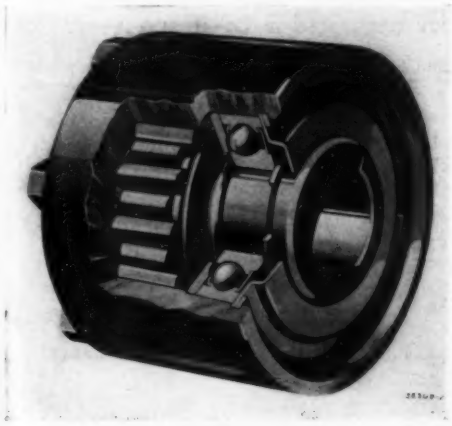
Further progress in the work of standardizing voltages for electrical equipment on Diesels has been reported by L. E. Lighton, chairman of the Electric Equipment Division of the SAE Standards Committee. A special subdivision will be appointed to handle the job, he announced.

At the February meeting of the Automotive Fuels Division of the Cooperative Fuel Research Committee, with which the SAE cooperates, it was recommended that, for the present, the group working on a suitable fuel-injection nozzle for the high-turbulent Diesel conversion of the C.F.R. engine, continue to use the Bosch nozzle originally fitted to the engine. At a later meeting, the C.F.R. Committee, following the recommendations of a reorganization report, decided to change the name of each group working under the Committee from "Section" to "Division." In the approved set-up the Automotive Diesel Fuels Division was assigned ignition-quality projects.

NEW MORSE CHAIN CLUTCH

A NEWLY designed high-torque indexing and free-wheeling clutch has just been announced by the Morse Chain Company, makers of power drive equipment.

Designed to fill the need for a simple, high-grade, inexpensive clutch to transmit power in one direction, this new unit's construction embodies some interesting features to ensure smooth, positive cam action and to eliminate ratchet noise and backlash.



In this new Morse clutch, multiple cams are used, spaced alternately with hardened ground steel rollers to distribute the load evenly on each cam — a feature which permits high torque loads without danger to the cam surfaces and allows greater cam contact surface for a given clutch diameter.

The cam action is governed by two leaf springs that contact shouldered surfaces milled at each end of the cams. The point of spring contact is such that a rocking action is created, with the fulcrum point at the center of the cams. Thus, when the speed of the inner and outer races synchronize, the cams immediately roll into a locking or driving position. The profile of the cams has been scientifically developed so that grip and breakaway are remarkably precise, without noise or shock.

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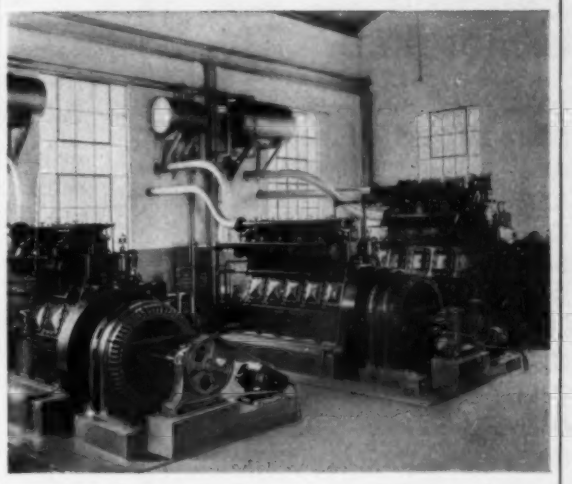

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Aviation Section by PAUL H. WILKINSON

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THIS new book on Diesel engines is entirely different from any other book previously published on the subject. In this new book fifty-seven Diesel engines are described in detail, illustrated in color and in full section.

John W. Anderson, author of the well-known book "Diesel Engines;" editor of "Diesel Application Planbook, Vol. One" and contributing editor to DIESEL PROGRESS, one of the most experienced and best known engineers in the Diesel industry, has described in intimate detail these fifty-seven Diesel engines. In this book he goes into the matter of individual design, discusses the features of design of each engine in clear cut, thoroughly understandable manner and makes it possible for the reader to grasp readily and quickly the differences between the various makes and types of engines now available on the market. He makes it possible to select from these fifty-seven different models the one engine fitted to the job in mind.

Beautifully illustrated in color, with sectional drawings visualizing with complete clarity the design features of each engine, this new book brings you under one cover a marvellously clear picture of the engines now available. Right up to the minute, as modern as tomorrow, printed on a big page size (10¼" x 13½") to make the illustrations readable, this new book is indispensable to the Consulting Engineer, Diesel Salesman, prospective Diesel engine buyer—yet the price is but $3.00 postpaid.

In addition to the section of this new book devoted to engine descriptions, nearly 150 pages of additional material of vital interest to you will be found immediately following the engine articles — see chapter headings hereunder. Your particular attention is drawn to the "Birth of the Diesel Engine" chapter because here you will find how the Diesel engine started, who was Dr. Diesel, what happened to him —original data never previously published on his early trials and tribulations—an intensely interesting chapter.

The blueprint section of the book, following the style set by volume one of the DIESEL APPLICATION PLANBOOK last year, will be found worth the price of the book. Eighty odd pages of new plans, new applications, bringing you up-to-date with what has happened during the past year in applying Diesel engines to varying power problems.

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(1) The Birth of the Diesel Engine
(2) Vibration Elimination
(3) Noise Elimination
(4) Flexible Connections
(5) Air Filtration
(6) Ponca City, Okla.
(7) Department Store Application Study
(8) Port Clinton, Ohio
(9) Sailors Snug Harbor
(10) Chicago Diesel Fire Boat
(11) 580 Fifth Ave., New York
(12) Mobile Ice Plant
(13) New York University
(14) Parke Davis Company
(15) Imperial Irrigation District
(16) LaPorte City, Iowa
(17) 8000 kw. Shanghai Plant
(18) 15,000 kw. Hydro Standby plant
(19) 22,000 hp. Mine installation
(20) Combination Hydro-Diesel-Steam
(21) French Community installation
(22) Paris, Texas, Observatory
(23) Langbein Cutlery Company
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DeLaVergne—all types
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Hercules—all types
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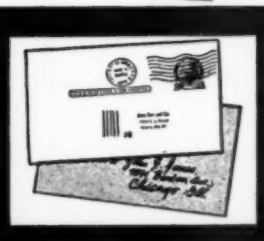

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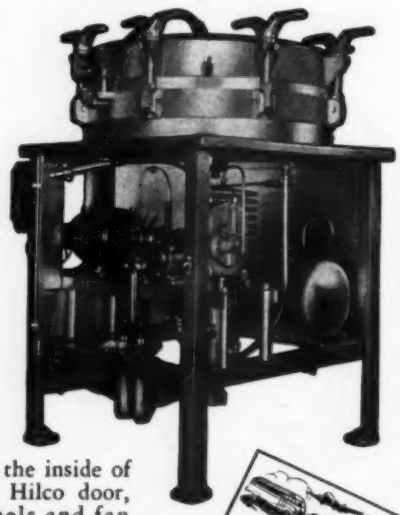

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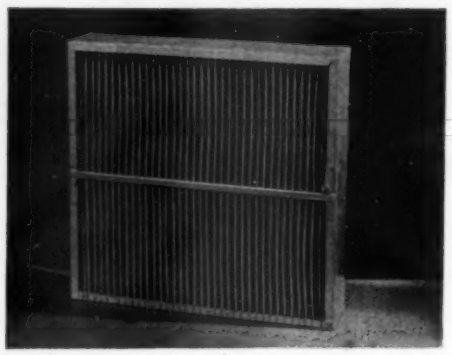
NEW LOW COST, FLAME-ARRESTING DRY TYPE AIR FILTER



RECENTLY announced by Staynew Filter Corporation, manufacturers of Protectomotor products, is a new dry type air filter possessing unusual advantages for industrial and domestic air conditioning.

The new filter, known as the WIRE-KLAD, has, among others, the particularly desirable feature of flame-resistance—fulfilling the provisions set forth in Section 150 of the National Board of Fire Underwriters, Pamphlet No. 90. Thus its installation is practical in many instances where fire hazard might otherwise exist.

The descriptive name, WIRE-KLAD, refers to the wire mesh reinforcement of the fins. The fin construction, a well-known Protectomotor principle, affords large filtering area in relatively small space. The wire mesh reinforces the filtering medium so strongly that the filter can be cleaned indefinitely by high pressure air or vacuum.

If exposure to oil or greasy substances makes cleaning with a solvent necessary, the wire reinforced filter insert can be easily lifted from the frame. Besides low initial cost and easy cleaning, this new filter also possesses the advantage of low replacement cost when finally worn out, as wire reinforced filter insert only need be replaced.

Standard and special sizes are available. There are three standard depths—2, 4 and 6", and four standard sizes—20" x 20", 16" x 20", 16" x 25" and 20" x 25". With the thought in mind that many installations require special sizes, these will be furnished at no extra cost if within reasonable limits. Full details may be obtained from the Editor, DIESEL PROGRESS, 2 West 45th Street, New York, N. Y.

A WATER-LOCKING VALVE

WATER and dirt contamination is a perfectly normal condition to be found in every fuel storage tank. Even though a tank and piping system may be 100 per cent tight from rain and surface waters, condensation and the danger of unloading water and dirt along with the fuel from tank cars and transport trucks is one of the most annoying problems in the every day operation of Diesel engines. The damage and delays caused from water in the fuel supply is well known among both Diesel designers and Diesel operators.

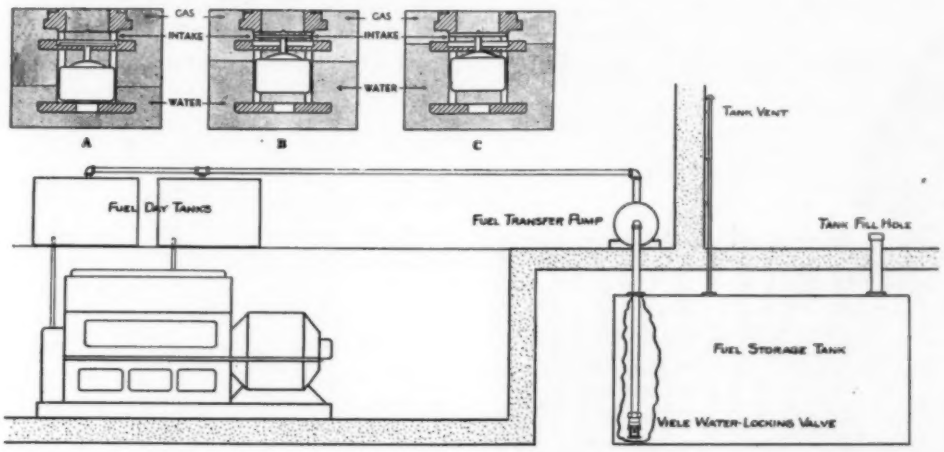
It is true that filters do take care of some of the water when it gets into the system but the dangerous situation exists when a quantity of water gets into the fuel line, completely filling the limited capacity of the strainers and overflowing into the engine. For absolute protection, every system should not only be equipped with a filter but also with a device which would absolutely protect the fuel supply under all conditions. This device should not depend upon possible human oversight and should be 100 per cent effective, regardless of the quantity of contamination present.

The valve illustrated fulfills these requirements by controlling this annoying problem at the source of the trouble, in the storage tank and away from the equipment.

Fortunately neither water nor dirt will stay suspended in the fuel. Fortunately too, the difference in the gravities causes the water and dirt to quickly settle to and accumulate on the bottom of the tank. An unprotected stub will cause this foreign material to be picked up by the suction from the fuel transfer pump where it goes on through the system to reap its damage.

In valve illustrated you will note that the intake is from the side only (Fig. "A"). As long

. . . . *And now please turn to page 61*



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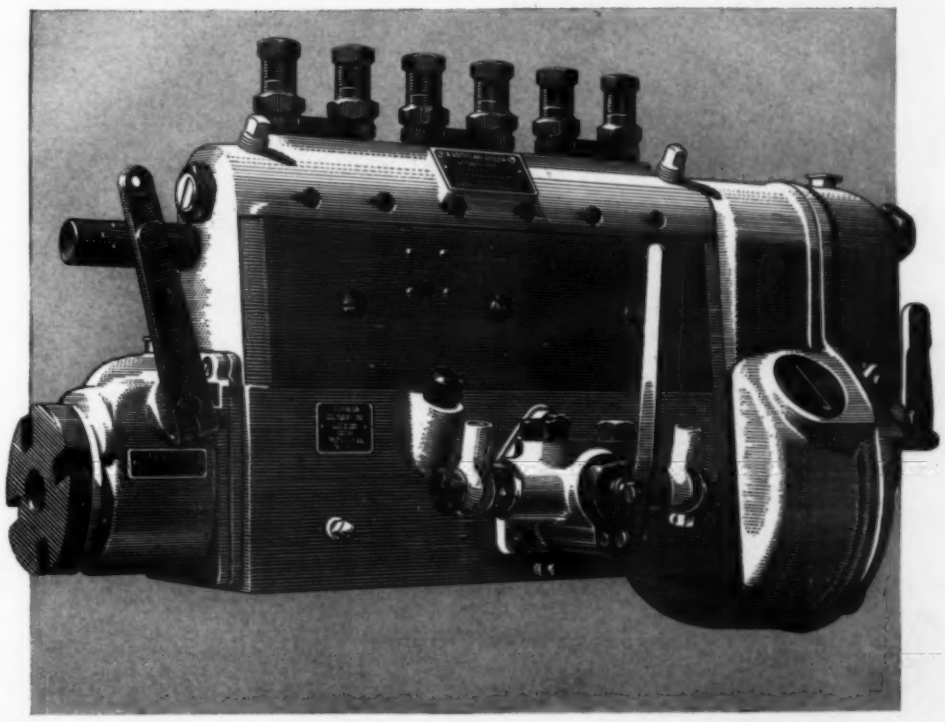

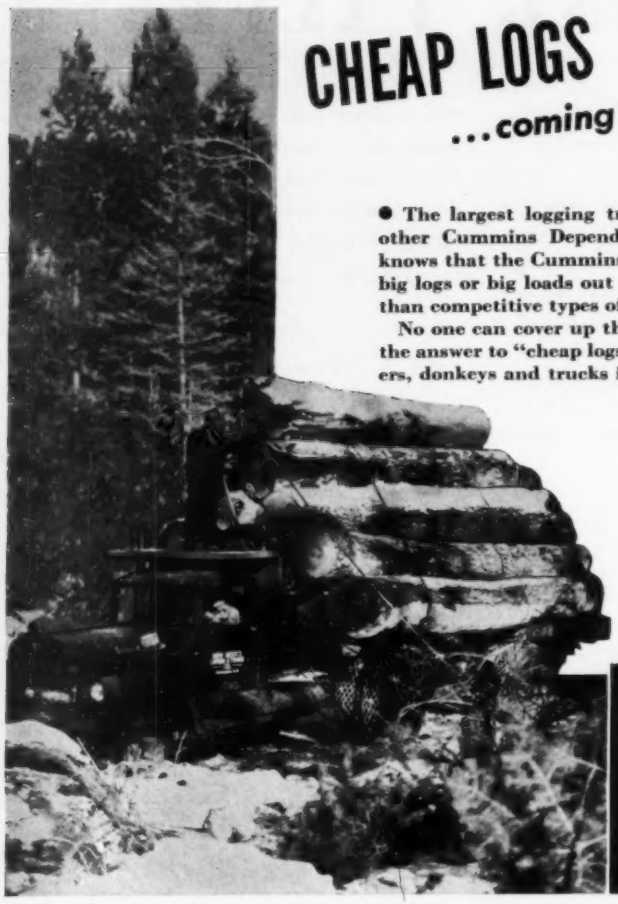

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SERVICING OIL-WASHED AIR CLEANERS

. . . . *Continued from page 46* . . . .

charged with the responsibility of giving the air cleaner equipment regular and constant attention in accordance with the instructions.

Service air cleaner daily. Remove oil cup—empty oil—scrape out dirt. Fill to oil level bead with engine oil. Replace oil cup securely. *Never remove oil cup while engine is running.*

The oil cup should be kept filled as nearly as possible to the level indicated by the bead with *fresh oil* the same as is used in the crankcase. Never use oil heavier than that used in the engine crankcase.

The best performance of the air cleaner is obtained by keeping the oil level up to the bead on the cup. Raising the oil level above this point *does not* increase the efficiency and this practice should be avoided.

It is absolutely necessary to change oil and thoroughly clean the cup whenever the level of dirt accumulated in the bottom of the cup reaches ½", or the oil appears too thick or heavy to spray properly. The depth of dirt at the bottom can be measured with a stick, screwdriver, or whatever is convenient. *Daily inspection* is necessary to enable the operator to see when any of these conditions have been reached.

Ordinarily, if the correct oil level is maintained with the proper grade of oil, the wire screen filtering element will need very little attention. However, the bottom of the screen should be inspected whenever the cup is removed and any accumulation of heavy lint, chaff, leaves or straw removed.

All connections between the air cleaner and carburetor should be inspected at frequent intervals and must be kept tight. *See instruction plate attached to oil cup.*

U. S. COAST GUARD OPENS BIDS

ON March 24th the U.S. Coast Guard opened bids for two 110-ft. Coast Guard cutters to be equipped with Diesel electric drive. While no contract has been placed prior to going to press, the apparent low bidder was Defoe Boat and Motor Works, Bay City, Michigan, bidding on General Motors Diesels and either Elliott or Westinghouse electrical equipment. On tabulating the bids apparently second low bid was Defoe with Cooper-Bessemer engines.

WATER-LOCKING VALVE

. . . . *Continued from page 59* . . . .

as the water contamination remains below the top of the float, where it is still considerably below the intake (Fig. "B"), it is the limit at which the fuel can be pumped. As the water level increases from that point, the float becomes buoyant and the suction immediately draws up the shut-off plate to lock-off the line. When the contamination is present in any greater amount, the float mechanism automatically rises with the water and self-locks. With the locked line, no liquid can be withdrawn from the tank through the discharge line until the dangerous water condition is removed, then the float will automatically drop back and allow normal pumping to be resumed.

The Viele Water-Locking Valve

With this valve, since the intake is in the area of clean fuel only, it allows the normal condensation to collect in the tank without fear of picking it up. At the same time if the water level becomes dangerous at any time, the valve is constantly "on guard" to prevent the entry of any into the system.

The valve is made in a number of styles and sizes both with and without a line check in sizes of 1½" to 6" with capacities up to 600 gallons per minute. These valves are inexpensive. It is practical to consider installing them on all tanks in service. Further information may be obtained by writing the Editor, DIESEL PROGRESS, 2 W. 45th St., New York, N. Y.

The 1938 Elco Motor Yacht 53

New Diesel motor yachts and cruisers

• Pioneers in the application of Diesel power in the cruiser field, The Elco Works presents in its 1938 Fleet a wide range of beautiful models with this modern type of power.

Elco has been outstandingly successful in making Diesel installations, even in smaller cruisers, thanks to its exclusive "Vibrationless Power" system of mounting the engine assembly in live rubber. Elco's "Vibrationless Power" mounting is considered almost as a "must" in Diesel installations by many experts. Its contribution to your cruising pleasure must be experienced to be really appreciated.

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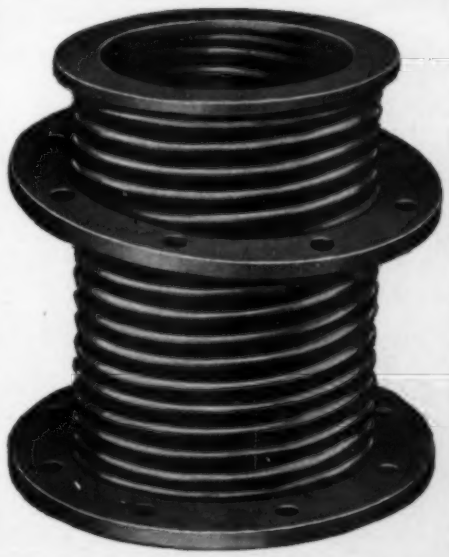

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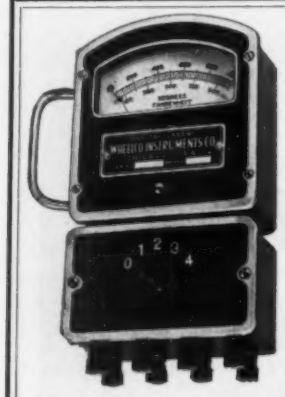

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THE Wm. W. Nugent & Co., Inc., have added three larger sizes of pressure oil filters to their list of five. The new filters are known as Figures 1116HA Sizes 8R, 8S and 8L. They feel a need for larger capacities in one unit rather than a multiple of smaller ones in parallel. The filtering surface of each is 4,609, 9,472 and 15,496 square inches respectively. The overall height of each is 18½" for all sizes. The flanged pipe thread inlets and outlets of each size are 1½", 2" and 2½" respectively.

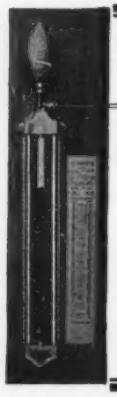
FIG. 1116 XK-8L

They will filter any liquid that is not destructive to the materials.

The construction and operation are like their well-known size No. 4L except there are eight textile filter bag elements wound around a central spool instead of four.

The range of operating pressure is 1 to 100 lbs. The operation temperature range is from the lowest the liquid will flow to 200 degrees Fahrenheit. Bolting down lugs or feet are welded to the filter shell and the exterior is finished in enameled gray.

Full information may be obtained by writing to the Editor of DIESEL PROGRESS, 2 West 45th Street, New York, N. Y.



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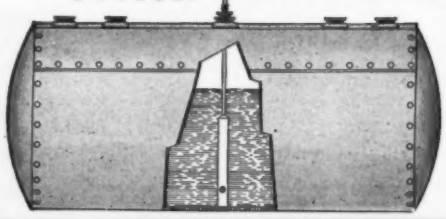

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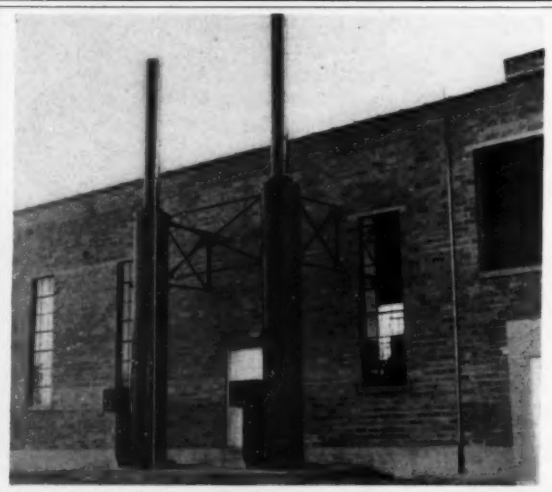

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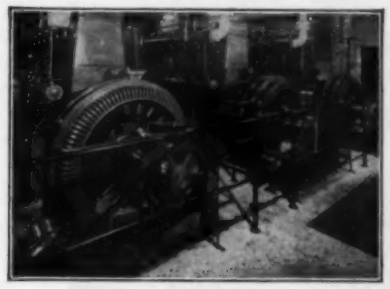

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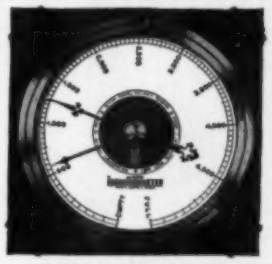

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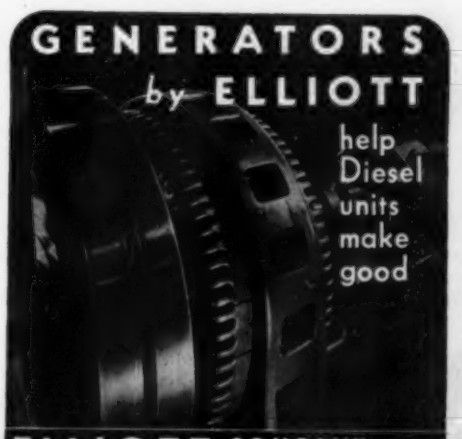

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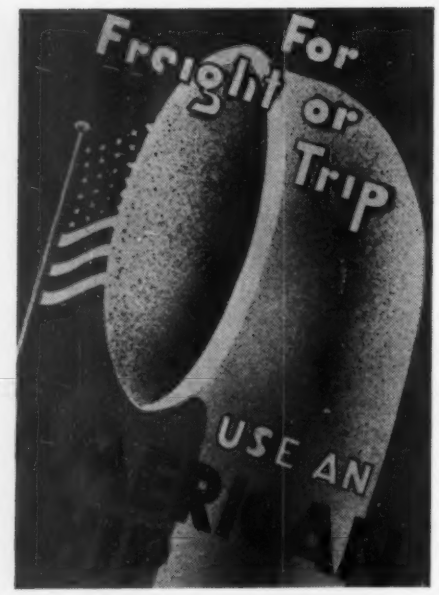

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"For Freight or Trips—Use American Ships"

FOR THE proper development of its foreign trade, for the transportation of domestic and foreign commerce, for national defense, the United States requires an adequate merchant marine capable of transporting its goods and serving the nation economically and efficiently.

The Propeller Club of the United States is a non-profit making organization, dedicated to the upbuilding of the American Merchant Marine. To interest the youth of America, who will be our voters and taxpayers in a few short years, in this subject, The Propeller Club is sponsoring this contest, with prizes offered for the best posters submitted emblematic of the American Merchant Marine, bearing the above slogan. Reproductions of some of last year's prize-winning posters are shown herewith, to give contestants an idea of the quality of posters considered of prize-winning quality.

CONTEST RULES

Only persons (either male or female) of 21 years of age or less on May 22, 1938, and who are residents of the United States, are eligible to compete.

Posters must be emblematic of the American Merchant Marine, and must bear, somewhere in the design, the following slogan: *"For Freight or Trips—Use American Ships."*

Posters must measure 18 inches in width and 24 inches in height, over all—that is, inclusive of margin or border. They may be in black and white, or in color, and may be executed in any medium.

All posters in this National Competition must be in the hands of National Headquarters, The Propeller Club of the United States, 17 Battery Place, New York, no later than May 1st, 1938, accompanied by entry blank, properly filled in, attesting to the age of the contestant.

Posters will be judged by a National Judges' Committee, to be appointed by The Propeller Club of the United States. All decisions of the Judges' Committee will be final.

Prize winners' names will be announced on National Maritime Day, May 22nd, 1938, or as soon thereafter as possible.

No posters will be returned to the contestants, but are to remain the property of The Propeller Club of the United States.

The Propeller Club of the United States reserves the right to employ any poster submitted in the competition as an emblem of the American Merchant Marine, and to reproduce such poster for purposes of advancing the best interests of American shipping.

CONTEST CLOSES MAY 1, 1938

PRIZE TRIPS

Contestants who submit the ten posters adjudged by the Judges' Committee the best submitted will be awarded FREE PRIZE OCEAN TRIPS on American ships—an opportunity to travel, to visit foreign ports, to study the way people live in other countries, and to enjoy the healthful recreation that can only be obtained on shipboard.

In addition, twenty CASH PRIZES, ranging from $25.00 to $10.00 each, will be awarded to contestants submitting posters of merit.

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(Date of birth)

Attested by: .....
(Signature of Contestant)

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(Address of Contestant)

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(City and State)

(Two signatures required, preferably school principal or teachers. If contestant is not a student in any school, have this blank attested to by two responsible persons of more than 21 years of age.)

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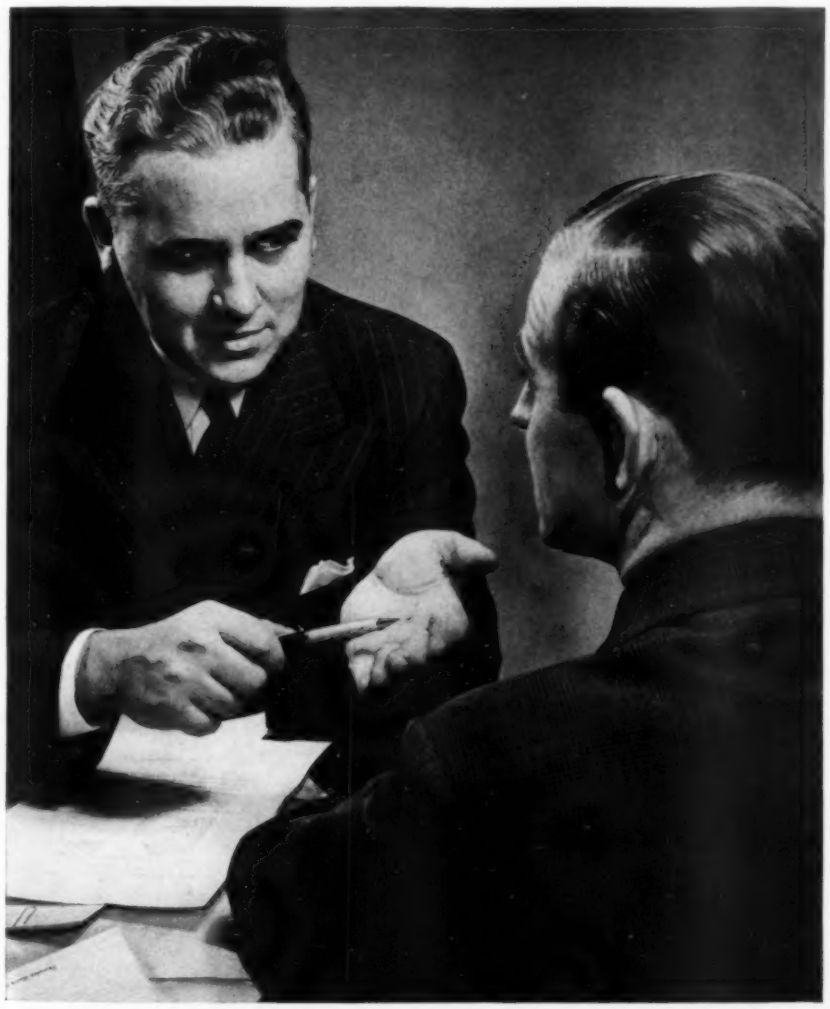

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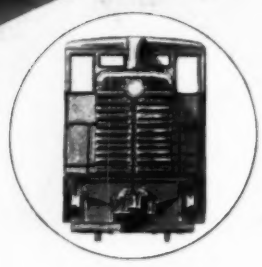

Cooper-Bessemer built two locomotives like the one pictured at lower right . . . and transportation men, everywhere, agreed that *here* was something new in switchers!

Now, a complete line of modern Diesel locomotives has been designed . . . in sizes ranging from 65-ton switchers to 135-ton transfer locomotives . . . a standard line, augmented by complete facilities for the building of special locomotives for special purposes.

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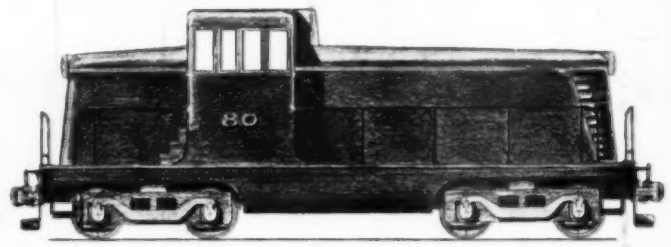
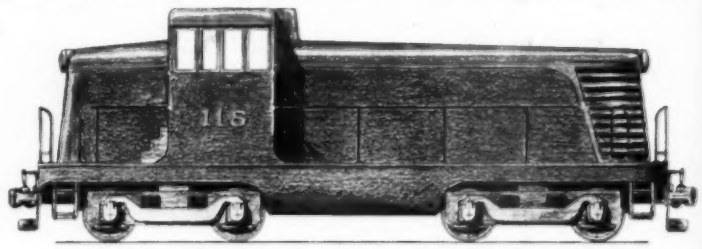
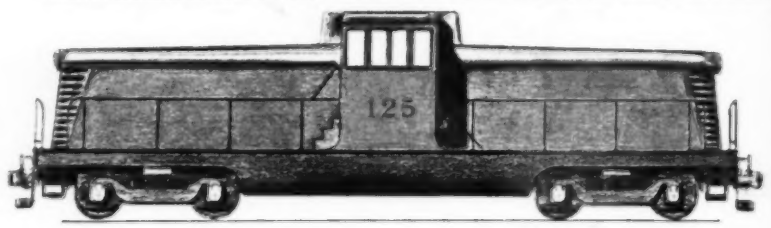


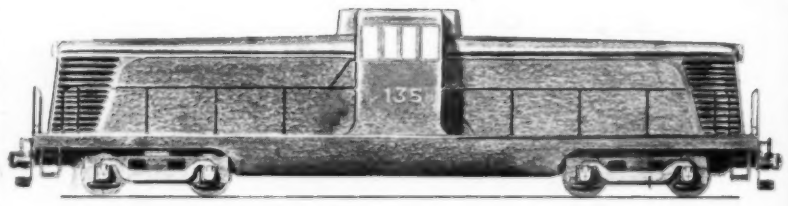
65-ton, single-engined locomotives, in 300 and 400 horsepower sizes.



80-ton, single and twin-engined locomotives, in 550 and 600 horsepower sizes.



115-ton, single and twin-engined locomotives, in 750 and 800 horsepower sizes.



125 and 135-ton, twin-engined locomotives, in 1100 and 1500 horsepower sizes.

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